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14 Complete

Suggested Outline For a Forestry and Conservation
"School of Instruction" for C.C.C. Camps
Under Direction of
The Pennsylvania Department
Of Forests and Waters

(This "school" will be entirely voluntary.
Lesson material is entirely suggestive.)

GENERAL

Workers enrolled in the National Conservation Camp deserve an opportunity to acquire a knowledge, not only of the immediate purpose and aim of their labors, which will result in more intelligent work, but of such back-ground information of the national and state forest and conservation status and policy, as will make for a better informed citizenship.

Running throughout the series of lessons will be a simple economic discussion of the basic national resource, land and its use, with emphasis on the forest use of land.

The workers should also have an opportunity to become acquainted with their camp surroundings - to learn to know the trees and native shrubs, (including the poisonous rhus), common wild flowers, birds, game, and other animals, and snakes (harmless and poisonous).

They should learn something of tree life and tree propagation, natural and artificial; forest stands; forest mensuration; forest management; forest protection; and wood utilization, as well as forest influences.

It will be impossible to go into these subjects in a detailed way and use college classroom methods. The method of approach must be objective, through tangible and concrete illustrations as far as possible.

Periods and Instructor

One hour a week - probably on Saturday forenoon - is suggested. This will be supplemented by field trips. The senior camp forester will be in charge, assisted by the Junior camp forester. Trained camp members may be found to help on hikes, etc.

The school hour might be divided into periods of 10 to 20 minutes each, so as to take up several subjects and maintain interest.

The forester should bring material for wood, tree, shrub, and plant identification and encourage the men also to bring in material for identification.

Illustrated lectures will be furnished by the Department, but it will be generally impossible to correlate these lectures with "School" work because of

the requirements of the lecturers schedules.

Field trips should be arranged after the "School" hour, to identify birds, trees, shrubs, animals, etc., as well as trips to nearby wood-using industries. They might include water supplies (to get forest-influence information at first hand), sanatoria, forest plantings, sawmills, paper mills, planing mills, wood using plants, and mineral developments, as well as to points of general interest such as look-outs, caves, lakes, dairy, fruit and general farms, etc., etc. Too large groups on these trips should be avoided by dividing if necessary into several groups.

Library and Reading Table

If possible loan of books on trees, birds, shrubs, butterflies and moths, fish and game, plants, etc., should be arranged through friends, or from local libraries for a reading and reference table.

Forestry and Nature Magazines may be provided either through a central State agency or by resourceful camp officers.

10 or 20 copies of Penna. Dep't. of Forests & Waters Bulletin #33 "The Common Trees and Shrubs of Pennsylvania" and other popular publications should be

provided each camp.

Instruction Facilities.

In the mess tent or assembly place there should be a blackboard, eraser and chalk for use of the "school" instructor. A serviceable blackboard is easily made from beaver or composition board with a smooth surface painted black and fastened to 2 x 4 uprights with inverted "T" shaped bases.

OUTLINE OF LESSON SUGGESTIONS

(Note - don't waste time on tree and shrub identification unless you have plenty of specimens for use and concrete illustration. Omit those not available. Collect material the day before the period.)

Lesson 1 Immediate instruction is desirable in plants and animals to be avoided.

(a) Poison oak. (3 leaflets coarsely incised). Handle specimen with gloves; compare with harmless virginia creeper (5 leaflets) and blackberry (3 leaflets finely serrate margin - prickles.)

Poison sumac. 7-13 leaflets, smooth surface and margin of leaves, resembling young white ash at a distance. Grows in moist places.

Note the volatile alkaloid nature of the poison. Wash with gasoline or denatured alcohol after accidental contact. Remedies prescribed by camp physician (usually metallic salts.) (5 min.)

(b) Poisonous snakes. Rattlers and copperheads only. Describe triangular heads, and body markings. Rattler easily identified - copperhead more difficult (10 min.)

(c) Land economics. Land as the basic resource. (10 min.)

(d) Tree and shrub identification - how to use the key in Vol. 33, Pa. Dept. F. & W. (20 min.)

(e) Identification of (1) local conifers - Pines. (10 min.)

(f) Questions. (5 mins.)

(g) Field trip.

Lesson 2.

(a) What is a tree? What is a forest? (15 mins.)

(b) Tree and shrub identification, conifers (concluded) - hemlock, juniper, arborvitae, larch, fir, spruce, shrub, ground hemlock. (20 mins.)

(c) Forest roads and trails. (15 mins.)

(d) Questions. Misc. tree identification. (10 mins.)

(e) Field trip.

Lesson 3.

(a) Forest influences; forest products; social services of forests. (15 mins.

(b) Tree and shrub identification (II) Broadleaf simple alternate leaved trees and shrubs; oaks; shrubby vines - bittersweet, green-brier, wild grape. (20 mins.)

(c) Protection of forests - fire prevention, detection, extinction - tools and methods. (15 mins.)

(d) Questions. Misc. tree identification. (10 mins.)

(e) Field trip. Fire line cutting and raking for "back firing". Have ranger or warden present with fire tools for this period.

Lesson 4. (a) Units of measurement in forestry. (Terms desirable for the lay citizen to know). Board foot log scale, cord, cu. ft., acre, stand in bd. ft. or cords per acre; cu. ft. or bd. ft. per acre per year growth. (15 mins.)

(b) Tree and shrub identification. Broadleaf, simple alternate leaved trees and shrubs (cont.); birches, beech, basswood, shrubs - hazelnut, alder. (20 mins.)

(c) Protection of forests - diseases - white pine blister rust, an alternate host fungus or rust on 5 needle pines and gooseberries or currants (Ribes) - Chestnut blight. (15 mins.)

(d) Questions. (10 mins.)

(e) Field trip.

Lesson 5.

(a) Our past and present forest resources - Nation and state. (15 mins.)

(b) Tree and shrub identification; broadleaf simple alternate leaved trees and shrubs; poplars, sycamore, shrubs, wild plum, hawthorn, gooseberries, winebark, sweet fern. (20 mins.)

(c) Protection of forests; deer, insects - white pine weevil, locust borer, (twig borers); gypsy moth (defoliators), southern pine bark beetle (bark borers). (15 mins.)

(d) Questions. (10 mins.)

(e) Field trip.

Lesson 6.

(a) How Trees Grow. Forest increment and its measurement. (15 mins.)

(b) Tree and shrub identification; broadleaf simple alternate leaved trees; elms, hackberry, sweet gum; shrubs - teaberry or wintergreen, spice-bush, sassafras (shrubs conspicuous to taste of leaf, bark or root). (20 mins.)

(c) Forest products, consumption, waste, balance of growth and cut. (15 mins.)

(d) Questions. (10 mins.)

(e) Field trip. To some wood using plant if possible.

Lesson 7.

(a) Our national forests (15 mins.)

(b) Tree and shrub identification, broadleaf simple alternate leaved trees and shrubs; tulip, cucumber, chestnut; shrubs - witch hazel, red bud, leatherwood, winterberry. (20 mins.)

(c) Using the axe in forestry - forest thinning, liberation and improvement cutting ("wolf" trees, "weed" trees), regeneration cutting, release cutting. (15 mins.)

(d) Questions. (10 mins.)

(e) Field trip.

Lesson 8.

(a) Pennsylvania's land and state forest policy. (15 mins.)

(b) Tree and shrub identification; broadleaf simple alternate leaved trees; mative cherries, juneberry, black gum; shrubs - huckleberries (vaccinium), arbutus. (20 mins.)

(c) Reforestation - natural, coppice, seeding. (15 mins.)

(d) Questions. (10 mins.)

(e) Field Trip. Study coppice and seedling trees and natural regeneration. Show how it can be stimulated and controlled.

Lesson 9.

(a) Forestry in Europe; high yields of tended forests, high income, relatively large labor employment. Notable reforestation projects. Exporting and importing nations, balancing cut and growth. (15 mins.)

(b) Tree and shrub identification; broadleaf simple alternate leaved trees; mulberry, osage orange, hop hornbeam, blue beech, shrubs - flowering raspberry, wild hydrangea, rhodo-dendron, laurels. (20 mins.)

(c) Reforestation - artificial, seed collection and storage, forest nursery, planting tools and methods, tree mixtures and spacing, rate of growth. (15 mins.)

(d) Questions. (10 mins.)

(e) Field trip. To a forest nursery if possible. Arrange to have nursery man present to explain methods from seed collection, extraction, soil preparation, planting, shade, weeding, lifting and shipping.

Lesson 10.

(a) Municipal forests in Europe, in the U.S. and in Penna. (15 mins.)

(b) Tree and shrub identification; broadleaf simple alternate leaved trees, completed; willows, persimmon, shrubs - black alder, meadow sweet, hawthorne (crotaegus)

(c) State distribution of forest tree seedlings. Planting, cost. (15 mins.)

(d) Questions, (10 mins.)

(e) Field trip. To varied forest plantations if possible with ranger and history of plantation.

Lesson 11.

(a) Management of forests, purposes, products, rotations, divisions. (15 mins.)

(b) Tree and shrub identification; (III) Broadleaf compound alternate leaved trees; walnuts, shrubs - poison ivy, virginia creeper. (15 mins.)

(c) Wood identification. Classes of woods - non-porous, diffuse and ring porous; resin ducts, medullary rays, spring and summer, sap and heartwood. Identification of conifers - resin ducts, pines, spruces, larches. (20 mins.)

(d) Questions. (10 mins.)

(e) Field trip.

Lesson 12.

(a) Forest taxation. Property taxes, yield taxes, Gov't. payments on Government forests in lieu of taxes.

(b) Tree and shrub identification; Broadleaf compound alternated leaved trees; hickories, shrubs - blackberries, raspberries, mountain ash. (15 mins.)

(c) Wood identification - conifers (completed) - no resin ducts - D. fir, redwood, arborvitae, juniper. (20 mins.)

(d) Questions. (10 mins.)

(e) Field trip.

Lesson 13.

(a) Idle lands; delinquent tax lands; the "new public domain". (10 mins.)

(b) Tree and shrub identification; Broadleaf compound alternate leaved trees (completed), locusts, Kentucky coffee tree, shrubs - roses, hercules club. (20 mins.)

(c) Wood identification; ring-porous hardwoods; white oaks, red oaks, chestnut, ash. (20 mins.)

(d) Questions. (10 mins.)

(e) Field trip.

Lesson 14.

(a) Advanced state and national forest policy. (10 mins.)

(b) Tree and shrub identification; (IV) Broadleaf simple opposite leaved trees; maples, catalpa.

(c) Wood identification. Ring porous hardwoods; hickory, elms, black locust. (20 mins.)

(d) Questions. (10 mins.)

(e) Field trip.

Lesson 15.

(a) Government control of private forest lands. (20 mins.)

(b) Tree and shrub identification. (V) Broadleaf compound opposite leaved trees, ashes, box elder, horse chestnut, buckeye. Shrubs - elderberries. (20 mins.)

(c) Wood identification. Diffuse porous, pores visible without lens; black walnut, butternut, birch, cottonwood, persimmon.

(d) Questions. (10 mins.)

(e) Field Trip.

Lesson 16.

(a) Summary - The economic position of forests in the nation. (15 mins.)

(b) Wood identification. Diffuse porous, pores not visible without lens; red gum, maple, tulip (Yellow pop lar), beech, cherry, basswood, sycamore, black gum. (40 mins.)

(Divide into additional periods if camp duration permits.)

(c) Questions. (5 mins.)

(d) Field trip.

MATERIAL SUGGESTED FOR USE IN

A FORESTRY AND CONSERVATION "SCHOOL"

IN THE CONSERVATION CAMPS DIRECTED BY

THE PENNSYLVANIA DEPARTMENT OF FORESTS AND WATERS

(Prepared by the Bureau of Research and
Information, Pa. Dept. F. & W.)

General. The success of this attempt to assist the men in the Conservation Camps orient themselves in their new work will lie largely in the effectiveness of the Camp Foresters in organizing and presenting their material. The School is voluntary for the men and its attendance may be small or large. An undoubted opportunity exists to improve the knowledge of the men in forestry and conservation, which will make for better and more enlightened citizenship. Our forest and associated resources must become more and more socialized both by increased public ownership and a greater measure of public control in private ownership. The progress of the movement depends on public enlightenment.

If the Camp Foresters have the time and reference materials the instruction may be modified and changed for the better. This suggested material is furnished to be of assistance to the Foresters and not to bind them. Specimens for tree, shrub, and wood

identification should be assembled in advance so that there will be a specimen for each 2 or 3 men to examine while the characteristics are being set forth by the forester. Wood specimens of local woods may be cut, and many of the kinds of lumber from other regions may be secured by a trip to a local planing mill from their remnant and refuse pile, or from old barrels, crates and packing boxes. While the periods are short, don't "slide" over the subjects. Drop out those of which you cannot secure specimens for illustration and increase the time on those which you can secure. If the men interested can be taught the common species of trees, shrubs and woods, and the features governing classification in the "keys" they can go on expanding their knowledge and that of their friends after they leave the camps. The results of these "instruction" hours may be looked back to as among the most profitable experiences of the camp life by the men you get interested.

The economic and statistical data are not offered to be committed to memory. They will enter the general background picture of forestry and conservation as related to the economic and social life of the nation, which will produce enlightened action when the questions of

public policy are periodically presented to the citizen electorate.

Construct a black-board and use the crayon furnished. A black-board sketch, however crude, will often clear up a critical characteristic of leaf, fruit or wood. Use the comparative method. Show how the white oak leaf or acorn differs from the red, black and scarlet oak or the sugar maple leaf from the red and silver maple, etc., etc. Pin up leaves side by side.

Illustrate wood pore and ray arrangement with black-board sketches. Simple hand lens may be had from Bausch & Lamb Optical Co., Rochester, N.Y., Catalogue No. 193, lens 1 inch in diam. flat handle zylonite frame going into vest pocket, 4 power, at $.60 each. Encourage note taking and drawing.

Foresters should have their tree, shrub and wood identification texts in camp.

Lesson Suggestions

Lesson I Immediate acquaintance should be made with poisonous plants and reptiles.

(a) Poison oak or ivy has compound leaves each with 3 leaflets generally coarsely incised. It produces white or ivory colored berries. It may be a climbing vine or semi-erect. It occurs in moist situations in the woods, along fences and roadsides. It is poisonous to touch to many persons, causing itching small water blisters, and in bad cases redness, inflamation and swelling. Scratching these blisters may spread the infection. When accidental contact has been made washing the hands or exposed parts with gasoline or denatured alcohol may prevent infection.

The harmless virginia creeper, 5 leaflets, is sometimes confused with poison ivy.

The plant is a member of the rhus or sumac genus. Its botanical name is Rhus toxicodendron.

Poison sumac (Rhus vernix) is a shrub or small tree, compound leaves 7 to 14 in. long with 7-13 dark green shiny leaves. The leaves have no "wings" along their stems (peticles). This shrub bears

yellowish white berries in loose drooping clusters. It is sometimes called poison elder and resembles an ash sapling somewhat. It generally grows in swamps and moist places. Its poison appears to be more severe and virulent than poison ivy but is similar in action.

(b) Poison snakes. The ratlle-snake and copperhead are the only 2 snakes that are dangerous and should be killed. Others should be protected. Both snakes are distinguished by their broad heads and relatively narrow necks. The rattler is easily identified by its rattles, which it generally puts into loud sounding vibrational warning when alarmed. Its color varies from gray to yellowish with darker bands and blotches transversely on its back.

The copper-head is more dangerous since it strikes without warning. It has a brown copper colored body with darker hour-glass markings arranged transversely, which make of the slightly lighter background somewhat diamond shaped markings. Besides the broad head and narrow neck, the tail has a black horny tip. This snake is rather thick bodied compared to the garter, milk, and water snakes.

These two poisonous snakes should be killed. Bites should be bled freely and poison sucked out by mouth (there must be no sores in mouth) and spit out. Tight bands should be tied above the bite to keep poison from the heart as long as possible. Anti-venom should be administered as soon as possible.

These snakes should not produce fear in the woods, but should suggest mental alertness and the training of the eye to detect them. Poisonous snake bites are extremely rare and death from such bites still rarer. The danger is prodigiously over-rated by the timid and people unacquainted with the forest. But these snakes are not to be toyed with. A common belief that these snakes can "jump" or leap at a person is fallacious. They cannot strike more than half or at most two thirds the length of their body - that is one and a half to three feet, maximum for Pennsylvania snakes. Larger southern snakes can strike a little further. A stick the length of an ordinary cane is long enough to dispatch a snake, (normal size in Pennsylvania), though one a foot longer might be more to the liking of the nervously inclined person.

(c) Land as the Basic Resource.

We wish to discuss for an all too brief period land as our basic resource. The primary human, physical wants are food, clothing and shelter. These come directly or indirectly to a large degree from the products of the soil through farm crops, farm and range animals, and forest products. To enumerate just a few of these products will illustrate the statement. Foods include wheat, rye and buckwheat flour, corn meal and a multitude of secondary products; garden vegetables; fruits; vegetable oils; meats; milk, butter, lard, poultry and eggs. Our two main clothing raw materials are cotton and wool, with a little silk and rayon. Our homes and factories contain much wood, as lumber, shingles and wallboard, or when built of stone and concrete, they used wooden scaffolding and forms. Our furniture, papers and books and larger implements contain much wood. Even our paints and varnishes use linseed oil (from flax), turpentine and rosin, largely products of the field and forest. A large proportion of our rural homes still use wood for fuel and farm fences.

Our soil husbandry and land management may thus be visualized as of the highest importance to civilized man. Even though we now use much mineral oil, gas and coal for heat and power, and stone, brick and concrete for building, the mineral fuel reserve supply

particularly has a limit. We do not know but that in a hundred years wood may be required to a greatly increased degree for fuel, and perhaps for the production of alcohol or gas as a power source.

The important principle to emphasize is that our basic resources may be classified as:

(a) Inexhaustible - such as the forces of nature, rivers and oceans for commerce, rain, climate, water power and some minerals of such common occurrence as clay and stone for building. But even water-powers may be ruined by missuse of the land surface on the watershed.

(b) <u>Exhaustible</u> - all our metal ores and especially our mineral fuels, coal, oil and gas are subject to exhaustion - once gone they are gone forever. We must use these carefully and sparingly.

(c) Exhaustible but renewable describes our agricultural, forest, and grazing lands. If we practice proper agriculture, pasturage and forest management we can renew these crops indefinitely. We have been doing this with much of the easier handled agricultural soils. Much of our farm land in Pennsylvania is producing as much or more than it did 50 years ago. But other lands such as those on steep slopes have been mis-handled so that they are

filling our streams, reservoirs and power dams with silt, and gulleying so badly that even forest trees may be established only with great difficulty. These lands should never have been cleared of their trees, but only lightly cut-over at intervals.

Probably our most abused class of renewable lands is the forest. Not satisfied with cutting the best, decade after decade, and leaving the cull and weed species to produce their kind, we have been burning over the forest lands stripped of their virgin timber until even the cull and weed species are crippled miserably and often no valuable kinds of lumber trees are left to seed in the ground, even if fires are now much reduced.

Our land resources may be classified according to use as follows (after the "Copeland Report", Sen. Res. 175, 72nd. Congress- By the U.S. Forest Service 1933):

(on following page)

	million acres	
Crop land in farms	413	
Pasture and range land		
In farms	379	
Not in farms	317	696
Forest land		
Commercial	495	
Non-commercial	120	615
Residence, roads and waste		179
Total land area of the U.S.		1903

From this classification we see that less than 20 percent of our land area is under crop, about 37 percent in more or less valuable grazing, and about 26 percent or just a bit over a quarter can grow commercial forest. Although we produce more farm crops than we need and we export almost 20 percent of them, we are carrying on in forest products by living largely on our virgin timber bank savings, and replacing through young tree growth much less than we cut. This will bring on a pinch in forest products sooner or later, unless we reforest on a large scale, and protect our natural young stands of trees from destruction by fire and insects and disease.

In addition to the continuous reduction of our merchantable forest growing stock, the remaining supply is largely in the Pacific Northwest while the largest consuming population is east of the Mississippi River. This situation makes for an unnecessarily expensive cross-haul since there are enough denuded lands east of the Mississippi to grow the multitude of forest products used in our homes, farms, transportation and communications and industries. It is the cost of this cross-haul of from $10.00 to $20.00 per thousand board feet of lumber that furnishes the economic opportunity of growing timber in the east at a profit. The large areas of non-agricultural land in the east must be kept in forest cover in any event to protect watersheds for large domestic pure water requirements, to prevent silting up the increasing number of water-power reservoirs, low lying farm lands and our navigable streams. Further our road improvement is rapidly bringing into use all our eastern wild lands for hunting, fishing and recreation. These social land uses are most important arguments for reforesting our eastern waste lands in addition to the wood and timber yields close to the consuming markets.

Pennsylvania Land Classification

Pennsylvania has in round numbers:

		million acres	
(a)	In active farm crop lands	8.0	
(a)	In active farm pasture (unwooded)	3.3	
	In forest land		
	(b) Gov't. owned	2.3	
	(a) Farmer owned	3.4	
	(c) Other private owned	7.4	13.1
(a)	In idle and waste farm	1.0	
(c)	In abandoned cleared farm	1.5	
(c)	In residence, towns, roads, R.R. etc...	1.8	
(a)	Total state land area	28.7	

This land classification indicates that about 46 percent or almost half of our land is now in forest or brush land, and about 2.5 million acres more is idle and abandoned cleared farm land, generally fit only for reforestation. This places over half of the

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(a) U.S. Census 1929.

(b) Correct as of Jan. 1, 1933.

(c) Estimate Pa. Forest Research Institute.

area of Pennsylvania in the forest use column. The building up of the naturally reforesting lands will require the development of a large mileage of roads and trails for fire protection and removing thinnings and cull wood, as well as for harvesting the final lumber and wood products. The reforesting of the waste lands not coming up naturally to timber will require a much larger forest nursery and planting program than Pennsylvania has yet undertaken. The citizens of the state must get a better understanding of the size of this reforestation problem. It is being thrust upon them by rapidly increasing abandonment of tax delinquent lands, whether they wish to handle the problem or not.

(d) Tree and Shrub Identification, Conifers, Pines.

Key to the Pines

1. Needles 5 in a sheath, slender ---------- White Pine.
1. Needles fewer than 5 in a sheath, usually stout --- 2.
2. Needles 3 in a sheath ---------- Pitch Pine.
2. Needles average 2 in a sheath ---------- 3.
3. Needles 5 to 6 inches long; cones with unarmed scales ---------- Red Pine.
3. Needles less than 5 inches long; cone scales armed- 4.
4. Needles very sharp and stiff; cones large and armed with stout prickles or spines - Table Mountain Pine.
4. Needles not so stiff; cones armed with slender prickles ---------- 5.
5. Needles (often 3 in a bundle), slender, straight; cones armed with weak prickles,--- Shortleaf Pine.
5. Needles stout, twisted ---------- 6.
6. Needles striate (stomatiferous lines); cones knobby but not prickly; upper trunk reddish, ---------- Scotch Pine.
6. Needles not striate, divergent; cones armed with weak prickles; crown open; tree often crooked- ---------- Jersey Scrub Pine.

All pines are evergreen (conifers) with needle-shaped leaves (clustered and held together by

a sheath and are cone-bearers). Usually attain merchantable size (rarely shrubs). Young trees in particular usually have the branches arranged in regular whorls, making it easy to determine their age (excurrent growth). Species are divided into two groups, namely Hard Pines or Yellow Pines (2 and 3 needle pines) and Soft Pines or White Pines (5 needle pines). Cones require two seasons to mature.

No other group of trees has played such an important role in the commercial development of our country. Each section of the United States is well represented with pines that are or have been leading factors in the history of the lumber industry. Our pioneer ancestors preferred white pine to any other wood found in the virgin forests of New England and the Middle Atlantic States. After the North Eastern states had developed the complete exploitation of their virgin timber supplies, the lumbermen invaded the Lake States with their wonderful white and Norway pine and hemlock forests. Later the southern pines came into prominence, not only for lumber and structural timbers, but also for tar, turpentine and rosin. At present the West is supplying the nation with wood products, no small portion of which consists of western yellow pine, sugar

pine, and western white pine.

In artificial reforestation, too, it is the pines that have led the way. Foresters prefer to plant pine because of its rapid growth, straight symetrical form, and the ready market for the products produced.

WHITE PINE

White pine belongs in the five-needle group of pines, that is, five needle leaves grow in a bundle. It is the only five-needle pine in eastern United States. The needles are slender and flexible, from 3 to 5 inches long, and encased during their first summer in a long silvery sheath at the base.

One of the tallest of our eastern trees, sometimes over 150 feet, and our most valuable conifer. A very fast growing tree, (considered the most rapid grower of any of the White Pine group, except sugar pine in California). Its wood has a wide range of usefulness, is somewhat resinous, soft yet firm, easily worked, rather durable; used for about everything except where great durability when exposed to the soil is demanded, or where strength, hardness, and toughness are exacted. Cones are long and slender and very different from all other

Pennsylvania pines. They are generally 5-8 inches long, quite resinous at maturity, composed of loosely arranged scales; cone scales not tipped with prickles as are those of the hard pines; the seeds are a staple food of the red squirrel which harvests the cones. Branches extend at right angles to trunk and are arranged in whorls.

The tree adapts itself to a great many habitats, (flourishes best in fertile, well-drained soils) hence has been used extensively for forestry purposes both in America and Europe (thrives in England, France, and Germany). In the past 35 years many hundreds of white pine plantations have been established in Pennsylvania. Is only a half-tolerant tree, but even when grown in dense plantations it holds its side limbs very persistently, requiring pruning. Doesn't grow equally well in allsections of our country - best stands found in New England, Middle Atlantic States and the Lake States. Two serious enemies, white pine weevil and white pine blister rust, have tended to discourage its use in reforestation during recent years.

White pine is, or has been, one of the most important timber trees of the United States, if not actually heading the list. As long as it was abundant

it surpassed all other woods of this country in the amount used. The forests of Pennsylvania once contained magnificent areas of white pine, at which time three-fourths of our lumber cut was softwood, the structural timber most in demand. Now our second-growth forests are 90 percent hardwood, including much cull material. As a timber tree white pine will not disappear from this country, tho the days of its greatest importance are past. Enormous tracts where it once grew will apparently never again produce a white pine sawlog. The prospect is more encouraging in other regions, and there will always be a considerable quantity of white pine lumber on the American market, tho the high percentage of good grades which prevailed in the past will not continue in the future.

At an early period the rivers were utilized for transporting the logs and the lumber to market, and that method has continued until the present time. Spectacular log drives were common in early times in New England, later in New York and Pennsylvania, and still later in Michigan and the other Lake States. Many billions of feet of faultless logs have been released from splash dams in the smaller mountain streams and gone down flooded rivers. The scenes in the woods and

the life in lumber camps have been written in novels and romances, and the central figure of it all was white pine.

PITCH PINE

Pitch Pine, next to white pine, is the most easily recognized pine among those native to Pennsylvania. It has many distinctive characteristics (see Pages 7 to 11 of Research Bulletin 2, "Pitch Pine in Pennsylvania"). Its needles are produced 3 to a bundle, - with occasionally 2. Its cones are intermediate in size between shortleaf and table mountain pine and are generally 1½ to 3 inches long and almost as broad at the base as long, when fully open.

Pitch Pine is the only pine tree native to the Northeastern United States that normally produces three needles in a cluster. It is now the most widely distributed pine in Pennsylvania, due principally to clear cutting and fires which favored its increase over vast mountainous areas. It flourishes under very adverse conditions. Makes its growth in installments. Is quite intolerant of shade. Produces water sprouts. Will sprout from the stumps (small trees in particular) -----

- very few conifers have such ability. Our most fire resistant conifer. Wood is resinous - was an early source of tar and turpentine. Pitch pine knots formerly served as candles in the pioneer cabins; long splinters tied into bundles served as torches.

Cones persist for many years; crowns of most mature trees are literally studded with cones of varying ages; will withstand severe heat from forest fires and the seeds within them remain viable. Cones frequently develop on young trees less than 6 ft. in height. They sometimes grow directly out of the trunk or branches, with the bark growing about and enveloping them.

The twigs of pitch pine are golden brown in color. After observing pitch pine, one is impressed by the fact that yellow is a predominant color - its foliage is yellowish green; its open cones, twigs, and the bark of mature trees all show yellow in their color scheme.

A tree of ordinary size, seldom exceeding 80 feet in height and 2 feet in diameter. At its northern limit of growth, in southern New Brunswick, it is seldom more than a shrub 12 to 15 feet high. At the southern extremity of its range, in northern

Georgia, it is a fairly large tree. In Pennsylvania, pitch pine trees have been found that measured 30 inches in diameter and 100 feet in height; the oldest trees recorded in the State were approximately 200 years of age.

Of good form when grown in well-stocked stands. Open-grown trees have irregular crowns and a shaggy appearance, often picturesque. Shows a striking range in elevation - in Pennsylvania, it reaches from the low agricultural lands of the southeastern and northwestern counties to the very top of the State's loftiest mountain (Negro Mountain in Somerset County) which attains an altitude of 3,213 feet. Is found growing in every county of Pennsylvania, but is most common in the mountainous regions. Many of the best natural stands of pitch pine found within its entire range occur in Pennsylvania.

Is most commonly found in association with such hardwood trees as rock oak, chestnut, scarlet oak, black oak, red maple, and black locust. Subordinate members commonly found in this group are scrub oak, black gum, witch hazel, dogwood, mountain laurel, and sassafras. Usually prominent on "barren lands," typified by endless stretches of scrub oak resulting

from repeated forest fires. Many successful plantations of pitch pine have been made in this State.

RED PINE

Has longest needles (4-6 inches) of any pine tree native to Pennsylvania; (hold in long silvery sheath, frequently 3/4 inch in length) foliage tufted at the ends of the branches, dark green in color, arranged in twos. Name red pine is appropriate since the bark has a pronounced reddish tinge, rather smooth by the flaking off of the outer plates; also called Norway pine because early explorers mistook this tree for the common pine of Norway. Cones unarmed, about 2 inches long ovate when closed, almost spherical when open. Noted for its symmetrical form, with straight clean columnar trunk, surmounted by small crowns in closed forest stands. Young trees are limby, with branches in distinct horizontal whorls, but early in life if shaded the lower limbs die and fall, leaving few protruding stubs or knots. None of its limbs are specialized or of great length. Leader not commonly attacked by weevil, hence the superior straightness of the tree. Generally occurs singly or in open groves

of moderate size in this State, not in extensive forest tracts as white pine and hemlock were formerly found.
Occurs only in the northern part of Pennsylvania.
A tree of rapid growth, (will equal white pine in early life) very popular for reforestation, with or in place of white pine. Much planted as an ornamental, and is rated one of the handsomest of northern park trees.
Seed costly, due to cones being difficult to collect (scattered on branches), and seed hard to extract.

A tree of poor dry soils in exposed situations; dry ridges, steep slopes, mountain tops, and dry sandy plains are its chosen home. Ranks next to white pine in its tolerance of shade; one of the very few pines that have been used successfully in under-planting.
Wood soft for a hard pine; fairly durable. Large quantities have been marketed in the Lake States as white pine. Formerly used in ship-building for masts and deck planks; modern uses are many and varied.
Why the tree should be called Pinus resinosa which means "resin pine", is very strange, for its wood contains less resin than any other hard timber pine in the East.

SHORTLEAF PINE

Twigs typically covered with a purplish bloom which distinguishes it from the lighter golden brown pitch pine twigs. The twig cross section is roundish while the pitch pine twig is angular. Needles rather short (hence the common name), not twisted, close set on the twigs, generally in 2's, sometimes 3's. Cones narrow-based, with thin-tipped, weakly-armed scales, 1 to 2 inches long, generally smaller than pitch pine. A tree of excellent form, with clean, stately, slightly-tapering trunk. Occurs on medium to good soils and at rather low elevations in Penna. Essentially a southern species, but extends into southern and central Pennsylvania - common about Mont Alto, Franklin County; only scattered specimens found north of Lykens Valley in Dauphin County.

The tree reaches its largest size and attains its finest stands west of the Mississippi River, particularly in Arkansas. Makes rapid growth. Reproduces excellently by natural seed regeneration. Next to longleaf, it is the most important of the Southern pines. Wood valued in structural work, for frames and heavy beams, flooring, siding, door and sash construction, and large quantities go into boxes and crates. Lumber cut from shortleaf pine is frequently mixt in the lumber

trade with other southern hard pines and sold as "Yellow Pine" or under some other trade name. Is less uniform in size and growth, and also in character of lumber, than some species, because of its great range, embracing varied conditions of soil, climate, and exposure.

TABLE MOUNTAIN PINE

Noted for its stiff, sharp needles, 2 to a sheath and massive (as large as the clenched fist) cones, heavily armed with stout recurved prickles. Cones 2-4 inches long, arranged in whorls. The cones may shed their seeds irregularly during two or three years, and sometimes hang on the trees for twenty years. Is a very aggressive tree and adapted for the regeneration of worn-out fields as well as to protect rocky slopes from erosion. Occasionally reaches a size that will yield lumber; trees 20 inches in diameter and with a clear length of 25 feet are not uncommon in the southern part of the State. A close associate of pitch and Jersey Scrub pines in central and southern Pennsylvania. When grown in well-stocked stands it shows just as good form and growth as other native hard pines (some very good stands of table mountain pine occur in Franklin and Huntingdon Counties).

The French botanist, Michaux the younger, has been criticized for the statement which he made more than a hundred years ago that this species was confined to a certain flat-topped mountain in the southern Appalachian ranges, and he called it table mountain pine. It lacked much of being confined within the narrow limits where it was discovered. It grows in New Jersey, Pennsylvania, Maryland, District of Columbia, Virginia, West Virginia, Kentucky, Tennessee, North Carolina and Georgia. It supplies timber in all parts of its range, but, except in very restricted localities, is not abundant. The lumber in the market is seldom distinguished from other yellow pines. Its forest form and open grown form are quite different; in dense woods the tree is tall, with good bole, but in open ground it is only 20 or 30 feet high, and is covered with limbs almost to the ground.

JERSEY SCRUB PINE

Called Jersey pine because it is a feature of the landscapes in the southern part of the state.

Needles short, diverging and twisted, sparse on the twigs. The thin-foliaged crowns, studded with persistent cones, readily distinguish this pine from any other found

in Pennsylvania. Crooked tree of poor form unless grown under dense forest conditions. Usually occurs in pure stands in old fields and on low shale foothills, such stands often being so dense that stagnation of growth occurs. (Scrub pine is inferior to most other yellow pines in self-pruning ability, so that density of stand is especially necessary). Propagates easily from self-sown seed, hence is soon found on the lower slopes of cut-over lands, and soon occupies fallow fields - is really entitled to be called "old-field pine". A tree of poor soils, but absent from higher elevations in Pennsylvania. It seeds in prolifically after fires of moderate heat, and resembles somewhat the jack pine of the lake region and the lodgepole of the Rocky Mountains in this tendency. A large part of the old field growth of Scrub pine consists of dense, fully-stocked stands, practically pure and even-aged. Has smoothest, thinnest bark of any native pine. Used principally for pulp-wood, mine props, and rough construction lumber. Grows from New York to South Carolina, and west of the mountains it is found in northern Alabama, Tennessee, Kentucky and West Virginia. Reaches its largest size in southern Indiana where it is sometimes 100 feet tall and

3 feet in diameter. Average size is small in the eastern states. Is very intolerant of shade. Unless it occupies very poor land - which it generally does - the growth is liable to be suppressed and crowded to death by broad-leaf trees before the stand becomes very old. Makes slow growth after 50 or 60 years, and is short-lived.

SCOTCH PINE

One of the most valuable timber trees of Europe; being planted experimentally in eastern United States. Foliage has a bluish-green cast. Needles striate and 2 to a sheath with lines of stomata on all sides. Buds usually resinous. Cones 1 to 2 inches long, slender-stalked, knobby, but not prickly, backward-pointing on the twigs. Like red pine in bark and regularity of growth, but of poorer form; often crooked. Wood brittle and trees susceptible to snow break. May be distinguished from the other pines of Pennsylvania by the reddish appearance of the upper part of the trunk and adjoining branches.

Tree grows very rapidly in youth, but later more slowly. Scotch pine has been grown extensively in the State forest tree nurseries of Pennsylvania and plantations can be seen in all parts of the State. As it

has not been grown to maturity for timber in this country, we know comparatively little about its economic value. Scotch pine in the Baltic provinces (particularly the Riga variety) invariably has straighter trunks and yields wood of a higher quality than that of central Germany.

(f) Questions.

Encourage questions, but avoid subjects too far afield and not interesting to the class.

(g) Field Trip.

The field trip should include as much illustration of the days lesson as possible. See poison ivy growing and poison sumac if possible. Watch for snakes. Identify trees and shrubs even if not yet had in lessons.

(Read over lesson in advance and collect material to illustrate tree seed, seedling trees, stump sprouts, root suckers, identification specimens.)

Lesson 2. (a) <u>What is a tree</u>? A tree is a large woody plant with a single stem or "bole" and a well defined crown. To be classed as a "tree" the woody plant must attain a height of 8-10 feet or over and 2 inches in diameter (Sudworth, Webster's Dictionary). For practical purposes the size requirement at maturity should be raised say to 6 inches in diameter and 20 feet in height. But any division between trees and shrubs must be arbitrary. Shrubs of our region may become small trees in another. In our work there will be little difficulty in keeping trees clearly distinguished except when they are young. Young stands of excellent trees are often mistaken for worthless "brush" and burned or otherwise destroyed by careless people who cannot identify young forest trees of desirable species.

Trees may be "evergreen" or "deciduous"; "conifers" or "needle leaved", and "broadleaf". "Conifers" are often taken as synonomous with "evergreens". This is not exact as the larches and bald cypress of the American conifers or needle leaved trees are

deciduous - shed their needles in the fall. There are a number of American Broadleaf trees (largely southern species) like live-oak, evergreen magnolia and others that are evergreen. The inter-change of the terms conifer and needle-leaved trees is better justified, though here too there are exceptions, as the yews which are not conifers but produce berries, are needle-leaved trees.

Again we speak of "softwoods", generally meaning conifers, and "hardwoods" generally to include the broadleaf species. But poplar and bass wood of the broadleaf group may have softer wood than the longleaf pine or larch of the coniferous "softwoods". These conflicts of popular terms and common tree names cause the scientist (forester, horticulturist and botanist) to use a technical vocabulary which is entirely accurate, but difficult for the unspecialized layman to understand.

Trees grow from (a) seeds, and from (b) cuttings and from (c) stump-sprouts or "root-suckers". (illustrate with material if possible). Seedlings more often grow slowly at first, while sprouts grow rapidly. Forest fires do more damage in coniferous

IRREGULAR PAGINATION

forest than in broadleaf forest because few conifers sprout well from stumps (redwood and cypress and to some degree pitch pine are exceptions). The broadleaf species more generally are stump sprouters, though here too there is a large difference. These differences will be taken up in Lesson 8, in "Reforestation".

Forest trees differ in light, soil, moisture, and temperature requirements. For this reason different forest trees grow in different places. White oak likes heavier clay soils than scarlet and black oak. White pine and hemlock like richer, moister and cooler soils than pitch and shortleaf pines. Pines generally like lighter, sandier soils than hardwoods. Generally different trees occupy ravines, and valley bottoms and ridge tops. Different trees predominate in northern Penna. from those in southern Penna. And widely different trees and forests grow in the northern United States from those in the Southern United States or Western United States.

<u>What is a forest</u>?

A forest is an association of individual trees either of the same kind or more often of mixed

kinds that thrive under similar conditions of soil and moisture. Sometimes shade enduring trees will be associated with light demanders as an under-story. Along with the trees which themselves develop an interdependence, are found shrubs and herbaceous plants, and on down in the soil many soil organisms are found. Then there are forest animals, birds, insects and fungi which have their influences in the development of the forest. A forest, therefore, is a very complex association of trees with other forms of life, often in a nice natural balance. Entrance of the unskilled axe, or fire, or the introduction of a new insect or fungus with no checks, may destroy the balance and severely injure a forest stand. Foresters after long experiences in Europe have learned that cutting away a mixed forest and replacing it with a planted forest of only one kind of tree may react in time so unfavorably on the soil and soil organisms, as to cause the forest trees to die wholesale, (Spruce in Saxony).

What does a forester do?

The forester, therefore, must learn very much about natural sciences - trees and how they grow,

plants, insects, fungi, animals and birds, to understand how to cut the timber crops with the least ill effect on forest conditions and continue tree growth at a maximum rate. In one kind of forest the method of timber management may be "clear cut and plant" with an evenaged forest resulting; in another it may be to cut only select large trees, keeping the forest intact and made up not of trees all of the same age, but of different ages in the right proportion of each - a "selection forest". The forester plants up old fields and bare places that are not naturally coming up with a stand of desirable trees. He may have to collect or buy tree seed and develop a forest nursery to grow young trees for planting.

He must protect the existing desirable forest growth from fire with a system of fire towers and telephone lines for detecting fires as soon as they start; organize fire crews of trained local men to promptly go to the reported fire and extinguish it. Well planned forest roads are a most important factor in forest protection. He must learn the life histories of insects and diseases (usually fungous) that kill forest trees, and apply methods of eliminating them

or holding them in check.

He must cut out young trees where they are too dense, unsound, of poor form, or undesirable species, and try to market the wood for sufficient at least to pay for the work.

He must understand and develop his markets for firewood, posts, poles, mine timber, ties and saw timber when ready to be cut.

He must cooperate with hunters and recreationists in locating forest camps and cottages and protect trees, shrubs and plants along the roads, since they help to make the forest beautiful.

He must look after sanitation on water-sheds from which domestic water supplies come.

He must plan his work and that of his labor force so that each activity will be fully accomplished in its season.

He must divide his forest into areas (compartments), find out how much timber of different ages is on each, compute its rate of growth, sum up the total wood growth per year for his forest and then plan his thinnings and timber cuttings so that he can increase his growing stock to the density which

will produce the largest annual growth or value. His cutting must not exceed the forest growth, so that our forests will never again be stripped and devastated, and the forest industries, forest farms and large labor income blotted out, but gradually replaced and built larger and larger.

Clear and permanent records must be kept for the forest capital, income and expenditure.

Why do we need forest research?

Many of the forest factors and conditions and their effect on the growing of wood crops are not yet fully understood. Forestry is even more in the experimental stage with us than in Europe since it is so much younger than European forestry. We have also much more complex forest associations - many more species of trees and more difficult economic conditions, higher wages and lower wood values. It is, therefore, absolutely essential that economical forest research be stressed here even more then agricultural research, where a surplus has been created. In Europe forest research is regarded as the very life of forestry even after several hundred years experience. Forestry will be a great success or failure with us, depending on the success or failure of forest research and experiment.

Tree and Shrub Identification -
conifers- concluded

Hemlock, Spruces, Larches, Balsam Fir,
Red Cedar (Juniper), Arborvitae, So.
White Cedar, Cypress, and a shrubby yew
("Ground Hemlock")

HEMLOCK (Tsuga canadensis) Adopted as Pennsylvania's State tree.

The Eastern hemlock is the only species of hemlock native to Pennsylvania; no other is commonly seen as an ornamental. Except for red cedar (Juniper), it is the only common native conifer, beyond the pines already discussed.

A tree often called "spruce" by the uninitiated; other common names are "Hemlock spruce" and "spruce pine;" all misnomers.

Leaves needle-like, flat, blunt pointed; about $\frac{1}{4}$ inch in length, attached by short thread-like stems, and occur singly on the twigs, generally 2-ranked. Branchlets seldom or never grow oppositely. From leaves and fine twigs is distilled "oil of hemlock," supposed to possess medicinal virtues. Cones very small, stalked and hang from the lower sides of the

branchlets; mature the first year and persist through the winter; even when ripe the cones do not spread open perceptibly, except in dry weather; good seed crops occur in alternate years. Bases of limbs and knots extremely hard; the woodsman requires a very sharp axe possessing hard and tough steel to trim a fallen tree.

Hemlock is readily distinguished from spruce by less sharp needles, flatter, with 2 white lines underneath; and 2-ranked. Also its cones are smaller than the eastern spruces.

Does not have its branches arranged in regular whorls as do many of the pines: whereas those of white pine are stiff and horizontal, the branches of hemlock are flexible and drooping at the tips. In youth perhaps the most beautiful of our evergreens, because of its flat sprays of foliage, dark lustrous green above, silvery beneath, and in early summer tipped with pale green new growths. The slender spreading branches are horizontal, drooping, with feathery foliage, graceful and plumelike; ranks high as an ornamental tree, also for protecting steep lower slopes, watersheds draining into reservoirs, and for under

planting. Capable of enduring heavy shade and unless grown in dense stands retains the lower branches to an advanced age; can support more trees per acre than any other native evergreen. Lacks the graceful taper of white pine, for the mature hemlock bole carries its thickness well up into the top where it tapers out abruptly.

Hemlock has been designated the official state tree of Pennsylvania, an appropriate title because it is common and has played a prominent role in the lumber industry of this state. Bark is valuable for the tanning of leather; it is deep-furrowed with chocolate red inner bark; has long been used by leather makers who generally mix it with some other bark or extract because leather tanned with hemlock alone has a redder color than is desired. Large areas of hemlock forest have been cut for the bark alone; now we are glad to utilize the wood which formerly was considered worthless. The wood is light, soft, brittle, weak, coarse grained, subject to wind shake, rather difficult to work, splinters badly and only the heartwood is moderately durable; largely manufactured into coarse lumber for framing and sheathing of medium priced structures; possesses remarkable holding power on nails

and spikes.

Hemlock is a social tree, fond of the society of its kind, often occurring is pure stands, but associated with white pine throughout its entire range from eastern Canada to northern Georgia. Perfers moist ravines and northern slopes, although often found well up on the sides and even the crests of high mountains in Pennsylvania and southward. In youth probably our slowest-growing eastern conifer; when its roots have developed growth is fairly rapid. Is quite shallow rooted. Reproduces abundantly on old rotten moss-covered logs and wherever mineral soil is exposed. Difficult to raise in the nursery; seed must be planted in the fall for best success; required acid soil conditions, dense shade, and plenty of moisture. The hemlock seedling cannot endure strong sunlight - mature trees must scatter their seeds in cool deep shade or they will do little good; when young trees are protected until they get a start they thrive nicely in the open.

SPRUCES

Key to the Spruces

Commonly Seen in Pennsylvania

1. Twigs pubescent; cones less than 3 inches in length.....2

1. Twigs glabrous; cones 3 inches or more in length 3

2. Foliage blue-green; cones persist for several years; margin of cone-scales jagged ...Black Spruce

2. Foliage yellow-green; cones drop the first year; margin of cone-scales smooth .....Red Spruce

3. Twigs yellow-gray; needles spiny; cones 3 to 4 inches long, ovate to oblong,Colorado Blue Spruce

3. Twigs reddish brown; needles not spiny, cones over 4 inches long, cylindrical .....Norway Spruce

All spruces commonly seen in eastern United States have four-sided needles, short and stiff, usually sharp pointed, originating singly and pointing forward at about a 45 degree angle over the entire upper surface of the young twigs. The mature cones are drooping and usually cylindrical to ovate in outline, with thin unarmed cone-scales. Trees are of very symmetrical growth, making them valuable for formal plantings.

BLACK SPRUCE (Picea mariana)

Inhabits our cooler sphagnum swamps. A northern tree of transcontinental distribution, extending from Labrador to Alaska and south to Pennsylvania and Wisconsin; reaches the limit of its southern commercial distribution in this State.

Individual trees vary greatly in size; usually a smaller tree and of more scrubby appearance than red spruce which it resembles so closely that identification from dead or dried material often becomes a matter of conjecture, even among skilled botanists. Foliage is dark blue-green in color, becoming lustrous at maturity, each needle with a curve towards the tip of the branch. Bark scaly, usually of an ashy gray color because encrusted with lickens, often reddish brown verging toward black.

Common name probably refers to the general appearance of the crown; the small cones, about 1½ inches long (the smallest of the spruces - becoming almost spherical when opened) adhere to the branches many years and give a ragged, black appearance to the tree when seen from a distance. Resinous exudations

("spruce gum") from this tree, also from red spruce, furnish the raw material for chewing gum - it is collected in the winter from punctures made on the trunk in the previous spring. Wood more knotty than red spruce, light, soft, very white in color; most of it manufactured into paper. The tree grows slowly, is shallow-rooted, and very tolerant of shade.

RED SPRUCE (Picea rubra)

Twigs tan-colored; covered with rough, short, brownish hairs; on older trees droop characteristically from the branches. Bark peels off in small, thin, reddish-brown scales (bark of all spruces is quite thin). Very tolerant of shade. Like all other spruces, the tree puts on a stiff, formal, compact and acutely conical crown when open grown; and when crowded it retains the same spire-like top of green limbs above the lower dead and dying ones. Often confused with black spruce, with which it is closely associated throughout much of its range.

In this state occurs only in or near swamps of the northeastern and central counties. Although black spruce predominates on high mountains in northern

New England and New York, with a considerable quantity of red spruce interspersed with it at lower elevations in some localities; in the Southern Appalachians red spruce is the only species found south of Northern Virginia. It is claimed that the larger spruce of West Virginia and the mountain region farther south (where red spruce sometimes forms extensive pure forests) has certain qualities of strength and texture combined with a larger percentage of clear lumber not approximated by the spruce of New England and Canada.

One of the paper pulp trees - your morning newspaper in the raw; the long fiber and white color of spruce make it one of the most satisfactory woods for pulp in this country; red spruce is only one of several species of spruce which contribute to the supply. Wood often chosen for flooring, and in use for general construction; especially esteemed for sounding boards of musical instruments.

Formerly spruce was little thought of for lumber and manufacturing purposes in this country, though some use was made of it from the earliest settlements in the regions where it grew. White pine could generally be had where spruce was abundant, and

the former wood was preferred. As pine became scarce, spruce was worked in for a number of purposes. The tree's form is all that the sawmill man could desire. The trunk has more knots than white pine, for the reason that limbs are a longer time in dying and in dropping off; but knots are small and generally sound. It is the wood's red tinge which gives the tree its commercial name.

COLORADO BLUE SPRUCE (P. pungens)

A silvery, pale gray-blue evergreen, the lightest colored of all the spruces. One of the prettiest and most popular of our ornamental conifers, usually characterized by perfect symmetrical growth. Native to a small elevated region in the Central Rocky Mountains. Not all trees show the blue color which gives rise to the common name. Grows slowly in early life.

Needles strongly incurved, stiff, and very sharp. Young twigs lemon-yellow, with a pungent odor if bruised. Buds pale ochre-colored, with basal scales rolled back on terminal ones. Cones about 3 inches long. The branches are horizontal, and the

foliage is dictinctly horizontal-layered. Needs sunlight to grow vigorously.

NORWAY SPRUCE (P. abies)

An exotic species, native to central and northern Europe, planted extensively in America. It is one of the spruces commonly seen in door yards and parks. Excellent for decorative effects,,wind shelters and bordering avenues, as well as for forestry purposes. Grows rather rapidly after about 10 years of establishment. A popular Christmas tree. Has largest and longest cones of any spruce that is commonly seen in the East. Twigs bright red-brown. Can be readily identified by the long, pendulous branchlets draping from the larger limbs of older trees.

Like all the spruces, its crown takes on a pyramidal form, though not so acutely as some native species. It has a habit of developing limbs between the annual whorls, but grows quite straight, with slight and even taper, and there are seldom any large or specialized limbs if grown in crowded stands. Its vigor, rapidity of growth, and freedom from insects and diseases, give indication that it will do well as a forest tree in our country. Should be planted on

moist fertile soil for best success; in its native land it is found growing in the valleys and well up the mountain sides towards the snow line, but diminishing in size and vigor as it ascends. The spceies, however, shows considerable variation in length of needles, color, branching and form. It is rather tolerant of shade and somewhat susceptible to late frosts.

LARCHES

The larches are unique among the coniferous group since they drop their leaves in autumn as do most of the hardwoods. Needles borne in rosettes or clusters containing upwards of 50 on the short spurs in early spring; later needles occur singly on the elongating shoots. Winter twigs, too, are characteristic, being covered with short knobs or spurs giving them a warty appearance. Foliage is light green in early spring, turning yellow in autumn. Whereas the cones of most conifers are pendant, those of the larches are borne upright.

The larches are picturesque trees, and their sparse, light, cool green foliage is dainty and in

sharp contrast with that of all other trees. Their tall and thin figure, narrow pyramidal head, and lace-like leaves all contribute to make them strikingly ornamental features of parks and gardens.

Key to the Larches

Commonly Seen in Pennsylvania

1. Twigs dark-brown; needles 3/4 to 1¼ inches long, cones 1/2 to 3/4 inches long ..... American Larch

1. Twigs not dark-brown (usually lighter colored); needles average longer than 1¼ inches, cones larger than 3/4 inch 2

2. Twigs golden-brown; needles glaucous beneath ... . Japanese Larch

2. Twigs yellow-gray; needles not glaucous beneath ..... European Larch

AMERICAN LARCH (Larix laricina) - "tamarack"

One of the boreal of eastern conifers, extending north beyond the Arctic Circle to the limit of tree growth; is also transcontinental from Newfoundland to Alaska. A moisture-loving species, commonly associated with black and red spruce, arborvitae, hemlock, black ash and other trees that can thrive in

swamps. A number of "tamarack swamps" exist in northern Pennsylvania. It is not a rapid grower at its best, even in preferred locations, and seldom attains large size. Shows much better form in the Canadian portion of its range where it occurs frequently upon higher ground, even on mountain slopes.

A graceful tree of regular, radial form, straight spire, and light feathery foliage which is deciduous. Branches sometimes crooked and irregular. With us a tree of the swamps, but growing thriftily when planted in rich ground. Common in certain parts of northern Pennsylvania. Has smaller cones (about 3/4 inch long) and darker twigs than European larch - conspicuous in winter when the branches are bare of foliage. Only native deciduous conifer of Pennsylvania; also the only species of larch native to eastern United States.

Bark on younger trees quite smooth, on older ones rough, not perpendicularly seamed, reddish-brown, with small, thin, almost rounded scales. Wood is very hard, coarse-grained, and durable especially when in contact with the ground. It is used chiefly for railroad ties, telegraph poles, fence posts, etc., and

sometimes for the interior finish of buildings. The Indians used roots of this tree as threads for sewing strips of birch bark together for canoes; the roots are long, slender, and very tough and pliant when growing in wet, mucky ground.

Larch forests frequently stand on ground so soft that a pole may be thrust ten feet deep in the mud. Sphagnum moss generally furnishes ground cover in such places. A tamarack swamp in summer is cool and pleasant- provided there is not too much water on the ground, and the mosquitoes are not too plentiful, but in winter a more desolate picture can scarcely be imagined; the leafless trees appear to be dead; but the first warm days bring them to life.

JAPANESE LARCH (L. leptolepis)

A tree native to central Japan. Occasionally seen as an ornamental in parks and on private estates in eastern United States. Shows promise as a forest tree in this country - foresters are experimenting with it. Its needles are covered on their lower surfaces with a bluish-white bloom that can be easily rubbed off. The golden brown twigs distinguish it

from the American and European larches. Its cones are about the same size as those of the European larch. Tree has a distinctive fragrance.

It is claimed that Japanese larch will grow on drier soils than any other exotic larch; in Japan it is usually found on volcanic soils. This has proven untrue in Pennsylvania. Grows very rapidly in youth.

EUROPEAN LARCH (L. decidua)

Another exotic tree (native to northern and Central Europe) that is commonly used for reforestation and ornamental planting in eastern United States.

Has yellow-green foliage and lemon-gray colored twigs - two helpful distinguishing characteristics. The twigs are stouter and yellower and the needles are larger than those of the American larch. Cones are small (1 to 1½ inches long), narrow, and have many scales. The branches of this tree are somewhat more pendulous than those of its American relative, particularly the lower limbs; the upper limbs tend to grow upright rather than droop; are straight and sparingly branched. Bark gray-brown

with thin scales.

BALSAM FIR (Abies balsamea)

Needles flat, solitary, minutely notched at apex; apparently two-ranked except on leaders (the spruces wear their hair pompadour, the firs part their's in the middle). Foliage glossy dark green above, silvery beneath; needles leave a round scar and smooth twig when shed. Buds blunt and buried in resin. Cones cylindrical, borne upright; fall apart at maturity leaving persistent axes. Twigs do not droop from the branches as do those of the spruces.

Like the American larch, this is a northern tree; the two are commonly associated in swampy areas of northern Pennsylvania, other boon companions being red and black spruce, hemlock and black ash. The bark is gray in color, smooth (entirely without scales) in the young or middle-aged tree, except where raised in the form of blisters, which are about hanf an inch across, and which when opened exude a transparent, fragrant, liquid gum - known as "Canada balsam". This gum is used medicinally, as well as a medium for mounting microscopic objects. This same resin or balsam renders

the foliage fragrant - the balsam spray bed and the balsam pillow are fragrant with sylvan associations to those who have camped or canoed much in the north woods.

The balsam fir is a symmetrical tree of fine appearance, the branches in even whorls, the tips aspiring. Commonly planted as an ornamental and the very best Christmas tree. Moderately valuable for lumber; used principally for pulpwood; the wood is light, weak, and perishable. The only native fir of the northeastern States.

RED CEDAR (Juniperus virginiana)

Has two types of leaves, the juvenile (linear or awl-shaped) - usually in pairs but at times in whorls of 3 - and adult (scale-like - occurring alternately in opposite pairs, giving twigs an apparent square cross section.) One of the darkest colored of the evergreen trees.

Grows principally on dry hillsides (particularly limestone and red shale soils) from Maine and Ontario southward and westward to the dry limit of forests. Grows slowly. Form is tall and narrow (conical) in youth, spreading in old age. The fibrous bark, naturally loosening, is often stripped off by

gray squirrels for lining their nests: stringiness of bark is characteristic of all cedars, and particularly red cedar. Trunk often ridged or buttressed at the base. Terminal shoots sometimes droop and are always quite fine. Berry about 1/4 inch thru, red brown to blue when ripe, often glaucous; birds commonly plant the seeds, particularly along fence rows.

Wood is light, soft, brittle, close-grained, easily worked, fragrant, durable; used largely for fence posts, lead pencils and moth-proof chests. Color of wood is red, with thin sapwood nearly white; exceedingly aromatic and noisy when burning and the embers glow long in still air. Pencil manufacturers have scoured the country to buy up all mature cedar available. Oil of red cedar, distilled from the wood, is used in making perfume.

Red cedar is often classed as a poor land species, yet it does not naturally seek poor land. That it is often found is such situations is because it has been crowded from better soils by faster-growing trees, and has retreated to rocky ridges, dry slopes, and thin soils where competitors are unable to follow. The trees often stand wide apart or solitary, yet they can grow in thickets almost impenetrable, as they do in some of the

southern states. It is an old field tree in much of its range; few American trees are so widely distributed.

ARBOR VITAE - Northern (Thuya accidentalis).

Foliage scale-like on flattened tan-brown twigs; dark green in color. Cones oblong, nearly 1/2 inch long, with 6 to 8 thin, oblong scales. Form usually a compact pyramid of dense, dark green foliage with short branches, very useful in ornamental plantings; horticulturists have evolved many decorative varities, varying in color of foliage and habit of growth, from pygmy globes to tall columns. Thrives well in cultivation, bears clipping and trimming well - produces a fairly good ornamental hedge. Foliage aromatic, arranged in fan-shaped clusters.

Bark is thin and cracks into ridges with stringy, rough edges; branches very smooth. Sap has a typical odor. Wood light and durable; chief uses are for fence posts, telegraph ples, shingles, and light boats. In a small way the deliciously scented, freshly split wood serves a useful purpose as kindling in making fires.

Found to the north and south of Pennsylvania, but not native to this State. Essentially a tree

of the north or of the colder parts of our southern Alleghenies. Commonly grows in swamps, in dense, almost impenetrable masses. Moose and deer, during the severe winters of northern Maine, "yard up" in the cedar swamps and subsist on the branchlets of the arborvitae until the snow disappears.

The wood of the northern white cedar possesses a peculiar toughness which is seen in its wearing qualities. A thin shaving, such as a carpenter's plane makes, may be folded, laid on an anvil, and struck repeatedly with a hammer, without breaking. It is claimed for it that it will stand a severer test of that kind than any other American wood. Toughness and wearing qualities combined make it an admirable wood for planking and decking for small boats. Its exceptionally light weight is an additional factor as a boat building material. The Indians knew how to work it into frames for bark canoes. Its lightness appealed to them; but the ease with which they could work it with their primitive tools was more important. It is a characteristic of the wood to part readily along the rings of annual growth. The Indian was able to split canoe ribs with a stone maul, by pounding a cedar billet

until it parted along the growth rings and was reduced to very thin slats.

BALD CYPRESS (Toxodium distichum)

Probably so named because of its deciduous habit - becoming "bald" in winter; a tree conifer, yet shedding its leaves in preparation for cold weather. One of the most valuable, as well as picturesque and interesting trees of America; a southern species but hardy and occasionally seen in cultivation as far north as Massachusetts. With light and feathery foliage and tall narrow form, the tree is of decided value as an ornamental.

Has appearance of pinnate - compound foliage in summer. Both the leaves and fine twigs are deciduous. Twigs yellow brown. Bark fibrous. Cones tan-brown globose, one inch in diameter, rugose, fall apart easily, commonly borne at the tips of the branchlets.

Inhabits the coastal plain region of the Atlantic and Gulf border. Preferred habitat is in wet places, or even flooded swamps. Characterized by buttressed bases and numerous "knees" (woody cones), the purpose of the latter probably to supply thru

their porous tissues abundant air to deep anchorage roots immediately below them and with which they communicate.

Cypress wood is famous for durability, upon exposure to soil, weather, or water - called "the wood eternal"; used for fence posts, shingles, exterior and interior finish of buildings, doors, sashes, etc. For the effective paneling of walls and doors it quite equals in beauty some of the more expensive imported hardwoods. A fungus disease pits much of the wood, but as in the case of a similar disease in white cedar, it stops when the trees are felled.

Cypress is a tree of slow growth. It is also a remnant of prehistoric ages; from southern swamps trunks are being dug up that fell hundreds, perhaps thousands of years ago, still perfectly sound. It is the only representative of the genus that occurs in the United States; only ono other species (in Mexico) is found in the world.

AMERICAN YEW (Taxus canadensis)

A shrub, also called "ground hemlock". Is commonly 2 to 3 or rarely 6 ft. high, with a straggling, procumbent to half-erect habit, growing

in clumps, with spreading branches. Leaves linear, evergreen; superficially resemble hemlock, but much longer, sharp pointed and sessile. Foliage is very dark green above, bright yellow-green beneath. Twigs green, much coarser than hemlock.

Common in shady, rocky woodlands, especially in evergreen woods. Being commonly found in the shade of old hemlock trees, the yew may upon first glance be taken for a young hemlock seedling; the differences, however, are quite distinct.

Fruit a clear, translucent red berry, waxy - looking, fleshy, cup-like, the top of the black seed within uncovered, resinous, about the size of a small cherry, extremely delicate in character and color; ripe in early autumn.

GINKGO

A tree that refuses to become extinct; a representative of other lands and moreover of other times. In very, very dim antiquity it was brother of the pine; but in this late day the signs of that early brotherhood are, if not faint and obsolescent, at least concealed from all but the microscopic eye.

Was once abundant in many parts of the world (even Greenland and America), now unknown as a wild tree. Preserved as an ornament of temple grounds in China and Japan, where it was long considered sacred.

Leaves fan-shaped like those of the maidenhair fern, but parallel-veined - hence often called the "maidenhair tree". The leaves are dull green, grow in alternating clusters of 3 to 6, and each leaf is characterized by a middle cleft and a long peticle. They turn a light yellow in autumn. Staminate and pistillate flowers grow on separate trees. Fruit fleshy and plum-like, pale yellow when ripe, with a single, bony, almond-like, nut-shaped seed; has very disagreeable odor, hence staminate or male trees are preferred as ornamentals. Nevertheless, in China the fruit is made into a preserve, or is baked and eaten at meals between courses as an aid to digestion; the kernel of stone is also prized as a food in China and Japan, where it appears very often in the market places.

A tree of strong monopodial tendency. Trunk and slender branches straight, the latter ascending, and set at an angle of approximately 45 degrees with the stem, forming a symmetrical ovoid

figure. Bark very dark brown, on young trees smooth, on aged trees rough and perpendicularly seamed. The twigs stout, shiny, yellow-brown, covered with fine shreds of bark, rigid and of two types - short spurs and elongating shoots. The effect of the foliage and ascending branches resembles that of the Lombardy poplar. Grows to a height of 100 feet, with a trunk diameter of 6 feet, in the neighborhood of the temples of Tokyo, Japan.

A near relative of the yew; a very ancient tree; native of northern China, but not of Japan where it was brought by the Buddhist priests along with their religion. Introduced into America in 1784, where it flourished in Mass., and along the St. Lawrence River in southern Canada to central Michigan and also farther south. At Washington, D.C. there is a splendid avenue of the trees on the grounds of the Department of Agriculture.

FOREST ROADS AND TRAILS

One of the interesting duties of the E.C.W. camps will be the development and maintenance of an adequate forest road and trail system. This phase of your work requires that the forester have enough engineering knowledge to enable him to make a road survey establishing the line and grade to be followed in construction. The Superintendent must know what is good practice in road and trail construction and be able to organize his construction crew and see that the work is carried through to completion at a reasonable cost.

Most of you who have been in the E.C.W. camp for any length of time already realize the importance of a good road and trail system in our forests, as a convenience in carrying on other forest activities. The three major objects of a forest road and trail system are:

(1) Better administration of forests

(2) More adequate fire protection

(3) To make the forest products accessible and open the forests for recreation such as hunting, fishing, camping and motoring.

In this, the motor age, with the automobile as the common mode of travel, we must have motor roads in all sections of our forests if we are to have quick and effective fire control and have the forests accessible for their greatest use.

Locating Forest Roads

Our State Forests are generally located in the mountainous sections of the State, where the land has little value for any other purpose than the growing of trees. Generally the main forest road follows the larger mountain streams from the low lands to the tops of the divides. In this way it is generally possible to obtain a satisfactory grade for motor traffic. When following a stream gives too heavy a grade for motors, trucks and automobiles, before reaching the top mountains, it is necessary to follow a grade up the mountain side and employ the switchback to reach the top.

The results obtained in road building depend principally upon the care exercised and the study made in the selection of a location. In choosing a road location, preference should be given to southern or

western exposure so the road will receive the benefits of the sun in wet weather and winter. The sun helps to keep the surface in a serviceable condition. Wet, swampy ground should be avoided wherever possible. Soil that appears suitable for a road in the dry months will be impassable as a road during the wet months and winter. This must be kept in mind when considering a location along bottom lands and creeks. A sidehill location slightly above the bottom of the slope gives a much better road bed, and helps in road drainage. The sidehill location often eliminates the necessity of stoning the road surface to make it serviceable. In selecting a location avoid very steep side slopes and hard rock if possible. Roads cut into earth side slopes that exceed twenty-five (25) degrees, are subject to slides in wet weather. Large quantities of hard rock make forest road construction too expensive. In selecting a location avoid all possible bridges as they are expensive to build and maintain and are always a hazard to traffic.

After the preliminary study of a road location has been made and the standard of road determined, we are ready for a survey. The methods

to be used are the simplest ones that will give the desired information for construction. For general forest work, the Abneys Level, the compass and tape will make a ground location and give the information necessary.

Grades

The maximum grade of a road determines its usefulness for heavy hauling also for light motor traffic in wet or icy weather. The grade of a road is the rise or fall from the level or horizontal plane. We speak of this in terms of per cent. A road has a 10% grade when the fall or rise is 10 feet in 100 feet of horizontal distance.

For a primary or base road a maximum grade of 8% is the limit we use. This is the same as used in mountainous country on the main highways of the State. On secondary forest roads where travel is light a 12% grade for short distances is allowed. The grade used on a mountain road determines the distance that must be used to reach a certain elevation. The less the grade used the greater the distance that must be traveled. A mountain with a one thousand (1000) foot elevation would require ten thousand (10,000) ft. of road to reach the top on a 10% grade while the same elevation

reached on a 5% grade will require 20,000 ft. of road. This comparison shows at a glance how the grade adopted for a road in mountainous country will effect the cost of construction.

Forest Road Alignment

In flat country long, tangent, and easy curves can be obtained in road construction at a reasonable cost, but to adhere rigidly to a definite standard of alignment in forest road work would increase the cost of construction of our roads beyond reason. We follow the contour of the mountain side rather than make extensive cut or fill to obtain road width, long tangents, and easy curves. We sacrifice alignment where the cost of construction would be expensive, providing the road obtained is safe to travel and will serve its purpose. For ordinary traffic speeds, a road alignment that allows 200 ft. to 250 ft. clear sight ahead will meet practical safety requirements. Sharper turns we protect with warning signs and widen the curve to aid traffic in passing.

Width of Forest Roads

Forest roads that are used extensively by

the public, require sufficient width for two-way traffic or at least 16 ft. width of road surface. On roads built primarily for forest development and protection, a 12 ft. width of road surface with intervisible turnouts for passing, meet our immediate need. Such a road can later be widened and further improved as traffic demands or the use justifies.

Clearing for a Forest Road

The foreman directly in charge of road work must have a knowledge of grades, road alignment, and curves. He must know how to use the information supplied by the location survey. The point of view of the forester as well as that of the road foreman should govern the cutting of timber for a proposed road. With the thought of conserving timber in mind, the road can be made to fit its surroundings. Whenever possible in clearing the right-of-way big trees should be avoided by shifting the center line of road to right or left and not hold rigidly to a fixed line. Shifting the center line four or five feet to right or left in a distance of 200 feet to miss a good stand of growing timber is good judgment and does not lessen the service-ability or mar the appearance of a road. In

our work we clear a 25 ft. width of right-of-way. The stumps are cut about 3 ft. above the ground to facilitate pulling later with a tractor. All brush and stumps are disposed of either by burning or by scattering in the wood at least 50 ft. away from the road in order that it will not be a fire hazard or unsightly to the eye. Large stumps must be loosened by blasting before the tractor can pull them. Timber and wood cut from right-of-way is to be piled neatly along side the road. After the stumps and brush are removed from road way, it is necessary to remove the stone. This should, in all cases, be used in road way where possible. If not possible to use the stone, it is to be deposited on the lower side of the road, rather than thrown on both sides which often makes it necessary to handle them twice.

Grading

The grading of a road should not start until the clearing and cleaning up of a right-of-way has advanced far enough so that one operation will not interfere with the other. In flat country the grading of a road is known as simple turnpiking. The earth is thrown up from either side and used to form the road

bed and surface. On road locations with a side slope up to 25 degrees, the construction requires the earth and stones to be moved from the upper side or (bank side) and deposited in fill to form the lower side of the road. This type of construction while slightly more expensive, gives a more satisfactory road as the drainage is better and generally the road material is of a better quality. It is important on sidehill locations that the first cut be made near the upper edge of the right-of-way, then as the road is widened the grader and a road plow will loosen the material to make the fill while if first cut is made too low the grader soon works in a side bank too high to be handled by the grader. This requires excessive hand labor to loosen the bank. In side slopes exceeding 25 degrees some hand bunching must be done before the grader and tractor can start operation, as the slope is too steep for the tractor to work. There should always be enough men to follow the grader and remove large stones and roots after each cut, that the grader may do effective work on the return trip. It is good practice to make the cut with the grader on the down grade and throw this earth over in fill on the up grade. This

method takes the greatest advantage of the motive power of the tractor. When the material to cut becomes too hard it is necessary to use a road or rooter plow to loosen the earth ahead of the grader. Also the plow is used to remove sharp breaks in the grade. It is interesting to follow the development of any road from the time it is ready for a grader until the surface is completed.

Drainage

We cannot have a serviceable forest road or in fact any serviceable road without proper drainage. In order to protect a road from surface drainage we give the road a crown of about 3/4 inches per foot of width from center to ditch on two way roads. On narrow 12 ft. roads this slope is made from outer side to the ditch. This slope or crown causes the water from rains and melting snow to drain to the ditch quickly and not lie on the surface, and soften it up. Under normal conditions a road requires about 10 cross drains per mile to conduct this surface water away from the road. The placing of cross drains requires study and experience. They should be placed with sufficient fall, approximately 1/2" to the foot from intake to

outlet, (but in any case a fall greater than the road or side drain fall) and have at least 1 ft. of covering at the center of the road. On all grades the pipe must be skewed from the right angle to center line of road enough that the wash will not settle at intake, but will be carried through the pipe and away from the road. Making the pipe fall greater than the side drain fall prevents slowing down the current of drain water and prevents dropping eroded material and a clogging of the drain.

In the spring and rainy season we have underground drainage which must be taken care of or mudholes and sink holes develop. These cases are generally taken care of by underground stone drains or by breaking enough stone in the road to support traffic. Again we have live streams that must be conducted across the road by either a pipe or bridges. Permanent stone or concrete bridges are costly. Money has not been available to construct permanent bridges. A good bridge can be constructed with stone abutments, wood or steel stringers and a 3" oak plank floor at less than one-third the cost of a so-called permanent bridge. A 10 ft. span concrete bridge will cost roughly $1,000.00 while a wooden structure the same

size good for 10 year service, will cost approximately $300.00. We avoid bridge construction wherever possible, by proper road locating, as bridges are traffic hazards and expensive to maintain and liable to be a complete loss in case of flood.

Road Surfaces

Earth roads built in a country where the ground contains a good percentage of shale have the most serviceable surfaces for earth roads. Shaley material compacts and makes a surface that is smooth, not easily affected by rain as the surface water runs off quickly and does not soften the surface. Clay and sandy loam on the other hand, make a poor road surface and generally require some shale or other suitable material placed on them to make them serviceable in wet weather. Where good shale is not available it is often necessary to stone such roads. In stoning such a road, we loosen the old surface with a Rooter Plow and throw this loosened material to the side to form the new shoulders or berms, leaving a smooth, even surface 10 to 14 feet in width in the center. Stones of medium size are then hauled on this surface and spread evenly and broken with sledges to about 2" maximum size. Some good earth or gravel is then placed on this broken

stone to bind it together. The surface is then rolled with heavy road roller. Care must be taken in this work or an uneven surface results, that is difficult to correct later.

Equipment

The most effective equipment for our combined operations of road construction and road maintenance with a small outlay of money, we have found to be the crawler type tractor and a good road grader. The weight of the road grader should not exceed 2/3 the weight of the tractor or be less than half its weight. For construction the large tractors with 60 draw-bar H-P are most effective but such equipment is too expensive for ordinary road maintenance. The Department uses the medium weight tractor with 30 to 35 draw-bar horse power. This tractor with a good 10 ft. blade grader, weight approximately 6000 lbs. will construct simple turnpike roads as cheaply as the larger outfits while on sidehill construction where the road width desired is approximately 12 feet, they are just as effective as the larger outfits. For wider roads, the larger outfits are more effective and cheaper to use. For effective, cheap construction the tractor and

grader are supplemented with a good scarifier, automatic revolving scraper, rooter plow and road roller. Where teams are available one or two good teams should be used to remove stumps from the roadway, and keep the newly formed surface dragged until it has packed under traffic. This team does such work effectively and relieves the much more expensive tractor for other work.

On steep side hill construction the gas shovels 1 to 1½ cu. yd. capacity, are most effective. A better grade can be obtained and a 20 ft. width roadway made at one operation. The banks are sloped by the shovel as the work is done and the completed project has a neat, workmanlike appearance. Such equipment requires little hand labor.

For hauling, the 1½ ton light dump truck is effective where the haul is not too long. This is the truck unit generally adopted for our work.

Construction Road Cost

Each road project has its own problems. The cost of construction of our forest roads with which you are familiar, varies according to clearing necessary, the amount of stone and rock encountered, and topography

of the country in which the road is constructed. This cost ranges from $800.00 per mile in rolling country free from stone, to $3500.00 per mile in the very rough country. Miles of road have been built in country where the road was practically built of stone moved by hand labor before the equipment could start operating. In such rough country the workmen must be always alert and use every precaution to avoid accident. Such sections require considerable blasting. This, in all cases, must be done ahead of the workmen far enough to avoid the possibility of hitting them with the flying rocks. Only experienced men may handle the blasting. Such men should not be careless ever in the handling of explosives.

I believe that each workman will derive great pleasure in following the development of each and every road or trail he helps to construct and will feel a satisfaction in the completed project of work well done. One can see the development grow from day to day and soon find that they are able to drive on a good road to sections where only a short time before they have had to climb that mountain on foot and the task with the necessary tools for their work was not too easy. Let us do our best on each project and make

each project better than the last.

(d) Question Period

Identify miscellaneous material presented.

(e) Field Trip

The field trip after Lesson 2 could well be spent

(a) In a trip to a water supply reservoir, or public camp, noting hunting camps and as many public services of the forest as possible. Point out erosion effects and water influences of the forest.

(b) List species of trees passed, birds and animals to bring out the association of living things in the forest.

(c) Examine a well laid out road. Determine the "grade" with an Abney level (or carpenters level held horizontal on top of a five foot stick, and note how many feet up grade the line of sight strikes the ground. This distance divided into the 5.0 ft. plus thickness of level - or height of eye from ground will give the road percent). Examine and criticise road for number and size of cross drains, angle laid and fall greater than that of road gutter. Could existing bridges readily have been avoided?

Lesson 3. (a) Why should we not let our forests be destroyed? Why are they so necessary?

The first reason is the social values of the forest.

Although difficult to prove by measurable data, forests appear to have an influence on climate. Large areas of forest decrease extremes of temperature and in all probability influence rainfall.

It has been demonstrated through measurements that forests equalize the run-off of rain and snow waters from mountain slopes and valleys. They, therefore, help to decrease floods and increase stream flow during low water stages. This is most important for such industrial centers like Pittsburg where millions of damage may be saved by decreasing the flood stage of the rivers a few feet.

A review of only a portion of the losses from floods in the United States since 1900 shows a total exceeding $300,000,000. Extended reforestation could reduce this materially.

Forests decrease erosion and protect slopes from gulleying and covering low farm lands with silt, as well as protect reservoirs, power

IRREGULAR PAGINATION

dams, and navigable streams from silting up.

Test plots* in Madera County, California in 1929 showed from 18 inches of rainfall over a period the following results: On unburned forest land the run-off was 4 cubic feet of water per acre with only a trace of silt. On burned land, similarly located, the run-off was 747 cubic feet of water which carried 108 cubic feet of silt with it from each acre.

As our rivers are canalized for low-cost freight hauling, and more and more power, irrigation, and stream regulating reservoirs are built, large forest areas on the watersheds will have increased importance. Reducing the silt content of the Mississippi river will much reduce the levee and flood problems in its lower valley.

Some of our conservation camps are located within a short distance of forest reservoirs furnishing clear drinking water to towns and cities such as Chambersburg, (under construction, Waynesboro, Scranton, Altoona and many others. York is reforesting its cleared lands around its reservoir and creating a most highly productive forest, as

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* California Forest Experiment Station.

well as protecting its water-shed. This will improve the quality of its water and give longer life and greater capacity to its reservoir through the reduction of silt whichdenuded slopes would otherwise sluice into it.

Irrigation reservoirs and works valued at over a billion dollars need the protection of forested water sheds in the United States.

San Francisco* has gone to the Hetch Hetchy Valley, 200 miles, for its increased water needs, and secured a reservoir on a forested water-shed, at a cost of 126 million dollars. New York goes as far as 92 miles and spent 66 million dollars. Boston plans to go 60 miles. New Jersey towns opposite New York City plan to spend 45 million for water supplies. Baltimore plans to spend 30 million. Philadelphia must soon go to river head-waters for a satisfactory supply. Forested water-sheds for these expensive reservoirs and works are necessary to protect the large investments and improve the water.

Dr. J.T. Rothrock, our"Father of Penn-sylvania Forestry"and our first Commissioner of

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* The "Copeland Report" by the U.F. Forest Service

Forestry, founded the first Pennsylvania state tuberculosis sanatorium within the Mont Alto State Forest. This is no mere coincidence. There is an aid to recuperative processes of the human body in the forest. The Appalachian Mountain forests of Pennsylvania, the Adirondacks of New York, as well as those of many other states contain an increasing number of sanatoria.

The increasing number of hunting, fishing and recreation camps on state and other forest land are abundant evidences that the rapidly increasing recreational use of our Pennsylvania forests will, in a relatively short time, justify the entire expense of our state forest system. But these restored forest lands will in time also furnish material wood products to a value above their maintenance costs and thus furnish all the important social benefits and services free to our people. For one or more of the above social services we should not only have state forests, but, county, city and town forests as well.

We might here cite the illustration of the Sihlwald, the city forest of Zurich, Switzerland. It is primarily an outing or recreational forest of about 4,000 acres. It is accessible to

the citizens of Zurich, and abounds in roads, trails, camping sites, sparkling brooks, and beauty spots. Yet for the year preceding the writer's visit (since the war) it brought in to the city treasury $25,000. net from timber, poles, ties, fuel wood and other wood products. This was a satisfactory return on the investment over and above all the social benefits of the forest. As the aims, and financial results of forestry practice are proven and become better known, municipal forests will increase in number.

The second reason for the re-establishment of our forests is the direct wood crops of all kinds necessary to our comfort and industrial welfare. In Lesson 6 will be taken up in greater detail the different kinds of wood crops that come from the forest, with the quantity and value of each. It is sufficient to note here that in all kinds of lumber, wood fuel, paper, posts, poles, ties, barrel and keg staves, veneers, mine timbers and many lesser wood products, we take from our forests 16 billion cubic feet of wood annually. That is 138 cubic feet, or a bit over 1½ cords of wood per capita (90 cu. ft. solid per cord). We should

have 360 million acres of well stocked forest to produce this quantity of wood products every year, and we do not have 360 million acres of forest in good shape.

Only two nations, Sweden and Finland use more wood per capita than we do. They are cold countries and exceed us in the amount of wood for fuel because they possess little or no coal, oil and gas fuels.

Our consumption has been falling due to the use of substitutes and economies (wood preservation). Some industries such as paper, pulp board and rayon are increasing their use of wood. Proper research for new wood uses and a plentiful supply of wood produced cheaply will maintain large wood markets, and develop new ones. Good examples of the increasing of wood consumption by new and meritorious articles developed by research are seen in cellophane and rayon. Another use of wood that is sure to grow with the disappearance of high quality virgin timber stumpage, is fiber board, illustrated by "masonite." A high pressure steam explosion of wood chips creates fiber which is then

pressed into fiber-board. This process uses any kind of wood and wood of small size and poor quality, like limbs.

Pennsylvania in particular has nothing to fear from energetic reforestation measures. Within its borders in 1928 it cut 239 million board feet of lumber, but it consumed 1760 million board feet. Thus it had to import 86% of its lumber consumption, generally from the far South or Pacific North West. On this we pay freight rates of from 40 to 90 cents per hundred pounds or $10.00 to $20.00 per thousand board feet. This was mentioned earlier as an excessive cross-haul cost, making reforestation of our own deforested mountain slopes and abandoned farms to a great degree economically feasible, even if the water, soil protective, recreation and other social requirements of our people did not contribute their paramount demand to such reforestation.

But another demand for reforestation beside the services of the forest to the people direct, and the value of the wood products, is the need of our people for employment. A stock company

forest in Germany of 12,000 acres employed 175 men all year, so that with little mountain farm homes they had a comfortable living. This is one worker for each 70 acres of forest, and does not include the additional labor in sawmills, planing mills, pulp and paper mills, and wood manufacturing industries. Entire towns and outlying farm communication have disappeared in the mountain regions of Pennsylvania, when lumber mills, paper mills, tanneries and other forest product industries were forced to shut down, through failure to re-forest our lands after removing the virgin timber. At present many more of these wood using industries and wood working plants are kept going by shipping in lumber and wood.

We will utlimately lose more of these industries unless we grow their wood supplies at home. Industry will follow its raw materials when these are bulky particularly. The wrapping paper industry is now moving south, the lumber industry to the Pacific Northwest.

The Conservation Camp army of 15 to 20 thousand men now in Pennsylvania forests could be doubled and permanently employed at a profit during

the gradual upbuilding of our forest lands. Unfortunately nature has all time at her disposal and will not be much hurried. Our reforestation plan must therefore be a gradual up-building over a considerable period of years. Pennsylvania does not yet own enough open land for immediate successful planting, to inaugurate a large tree planting effort such as New York has undertaken. The 15,000 men in the conservation camps can plant out the 10 to 12 million trees ready to leave the state nurseries this fall or next spring in 2 days. We have been trifling as a state with a much larger and more acute state problem (reforestation) than the public has realized. Our forest and abandoned farm lands have the power to absorb large quantities of idle labor with an ultimate profit.

(b) Tree and Shrub Identification -

Trees With Alternate and Simple Leaves (Broad Leaved Trees).

The Oaks; also Climbing Shrubby Vines -

Bittersweet, Green Brier, and Wild Grape.

THE OAKS (Quercus)

(Simple Means of Identification)

Lobes of leaf rounded (smooth); buds usually blunt; acorns mature in one season; nut shell usually smooth within ..... White Oak Group

Includes such species as white oak, post oak, bur oak, rock oak and swamp white oak.

Lobes of leaf bristle - pointed; buds usually acute; acorns mature in two seasons; nut shell usually pubescent within ..... Black Oak Group

Includes such species as black oak, red oak, scarlet oak, pin oak and scrub oak.

The oaks are characterized by simple leaves, either lobed or coarsely toothed; buds clustered at the ends of the twigs; a star-shaped pith (when viewed in cross section); fruit an acorn set in a deep or shallow cup; wood ring-porous, pith rays prominent. As a

rule, trees of the white oak group make slower growth than those of the black oak group.

WHITE OAK (Quercus alba)

An oak of great economic value; one of the most important American hardwood trees. The wood of this tree, more than that of any other, built the log cabins, barns, mills, bridges and forts of the early settlers, while the occurrence of the tree was a guide to the pioneers in selecting the land for their farms, as they soon learned that an abundance of white oak was a pretty sure indication of fertile soil. The forests of such rich agricultural areas as the lower Susquehanna (Lancaster and York), Lehigh, Lebanon and Cumberland valleys in Pennsylvania were densely covered with this tree.

White oak attains large size and is widely distributed in all the states east of the Mississippi River - few, if any, trees occur as evenly over their range. In the open, the trunk is short, the branches heavy and wide-spreading, the form typically broader than high; trees in dense forest stands have long, clean boles with little taper, bearing aloft a narrow crown.

Bark light gray, loose, scaly or shed in narrow strips on trees occupying fertile soils; frequently, as on poor rocky sites, it becomes firm; furrowed into deep, perpendicular ridges, with narrow, long, flat scales. Twigs slender, gray to reddish brown in color, smooth, sometimes with a slight bloom; buds rather small, obtuse. The leaves are bright olive-green above, much paler and smooth beneath (fine-hairy when very young), and are deeply divided into 7 to 9 blunt, rounded lobes; wedge-shaped at the base, about 4 to 7 inches long, obovate in outline. Staminate flowers in long, slender, threadlike catkins, appearing in May - June.

The light brown acorns are commonly borne in pairs, with an ovoid nut and hemispherical cup, the scales of which are knobby but become small and thin at the rim; the meat sweet, edible; mature the first year. White oak acorns are valuable food for game, particularly squirrels, wild turkeys, ruffed grouse, and deer; used as food by the Indians and early settlers. Does not bear fruit in early life - seldom under 50 years.

Wood commonly quarter-sawed to bring out the grain to best advantage - rays prominent; one of the most important veneer woods. Uses for the wood are almost infinite; good for nearly anything for which any wood is

used; ranks high in shipbuilding, general construction, furniture, finish and fixtures, agricultural implements, car building, vehicle stock, tight cooperage, and many other industries.

Makes rather slow growth. Is extremely long-lived; a rather poor sprouter; decidedly light-demanding. Reaches its best development on the lower slopes, and foothills of the Allegheny Mountains, and in the Ohio River Valley.

Leaves often cling all winter (some other oaks have the same habit); in some sections white oak coppice is known as "red brush". Its leaves, bark, and form are quite distinctive and make it difficult to confuse this tree with any other.

POST OAK (Q. stellata)

Easily recognized in summer by its peculiar leaves with enlarged upper and middle lobes. Leaves thick in texture sometimes almost leathery; upper surface very dark green, smooth or slightly roughened; under surface grayish green, or even tawny in color, because of the covering of branched hairs - the scales of the acorn cup, the nut itself, and the young twigs and buds are all more or less rusty - pubescent from the same cause. Leaves appear to be tufted

on the ends of the twigs; are bilaterally developed with a large, obtuse lobe on each side, about in the middle, giving them a maltese cross effect; (this is the most conspicuous difference from white oak to the layman); very persistent, clinging on the trees until the new leaves push them off in the spring.

The heavy branches have more angular and kinky curves than most other oaks, separating often, with wide angles, forming "knees" which formerly were used in wooden shipbuilding. Bark resembles that of white oak, but is generally rougher and darker in color. Wood also is similar to white oak; is very heavy, hard, close-grained; tough, and durable in contact with the soil. Is is something to the tree's credit that, except the yellow oak, it has the greatest specific gravity of any of the oaks which grow in Pennsylvania; in resistance to a transversely applied crushing weight there is no oak in our state which is the superior of this little post oak.

Name given to the tree in pioneer days when its wood was used principally for fence posts. Called Iron Oak among shipbuilders, in reference to the heavy, close-grained wood, declared to be "as hard as iron".

A southern tree, reaching its best development in the upper Gulf states west of the Mississippi. Seldom

attains large size in Pennsylvania; varies greatly in size throughout its range. In Florida it becomes reduced to a mere shrub - thence it extends north to Massachusetts and finds itself at home on the sands of Nantucket and Martha's Vineyard islands; grows also in Ontario, Michigan, Nebraska, Kansas, Oklahoma and Texas.

Generally occurs in pure clumps (sometimes associated with red cedar) on poor soils - limestone uplands or dry, sandy or gravelly soils seem to offer the best conditions for its existence. Form not ideal from the lumberman's viewpoint; tree does not prune itself well; straggling limbs adhere to the trunk and prevent the clean bole which often makes white oak so attractive. The uses of post oak for building and manufacturing purposes are the same as for white oak, excepting that it is not so extensively employed.

BUR OAK (Q. macrocarpa)

This species cannot be regarded as one of our common trees in Pennsylvania. It ranges as far north as Nova Scotia, south and west to Texas, but generally keeps to the west of this State. It prefers the rich bottom lands and prairies of the west, although it is found in most states

east of the Rocky Mountains - few American oaks have a wider range (one of the very largest of American oaks). Attained largest size in Indiana and Illinois.

Bur oak is a name suggested by the acorn which has a fringe around the cup like a bur. The acorn is typically very large (extremely variable in size throughout its range), about $1\frac{3}{4}$ inches across the hemispherical cup which, with its frayed and ragged edge (the coarse upper scales are long-awned), resembles a miniature bird's nest, and covers about one-half of the acorn (sometimes almost entirely encloses it). This acorn is the most conspicuous point of identification of the bur oak to a layman.

The large leaves are from 5 to 8 inches long, lustrous deep olive green, much paler beneath and white-wooly, with 3 to 4 notched and rounded lobes on each side, (and deep rounded sinuses that reach almost to the midrib); obovate in general outline; large terminal lobe rather squareish; base of leaf wedge-shaped. They turn a dull rusty or maroon red in autumn. Its foliage forms a beautiful mass and, owing to the difference of color on the upper and lower surfaces, shows a delicate shading when the leaves are in motion.

Branches usually have corky-winged projections, or flattened keels of bark, along their sides; some of the wings are an inch or more wide; they are apt to escape notice

when the tree is in leaf, but in winter the bare twigs look rough and ragged. Buds slightly pubescent, acute or obtuse; lateral ones appressed. Bark deeply furrowed, with a tendency to become flaky.

An attractive ornamental and shade tree; withstands smoke and has few insect or fungous enemies. Makes slow growth and is rather intolerant of shade. Wood frequently goes to market as white oak. As far as can be foreseen, bur oak will fare in the future about like white oak; that is, few trees will be left standing long enough to attain large size, because it will pay better to cut them while comparatively small.

SWAMP WHITE OAK (Q. bicolor)

The characteristic which best fixes this tree in the minds of most people is its preference for low, wet soil, such as stream banks, yet it is not really a swamp tree; prefers river banks and borders of marshes, but grows best in situations out of reach of all overflow, and often side by side with silver maple, hickory, black ash, and pin oak. Is nowhere very abundant, though it can occasionally be found in small groves. Reaches its best development in western New York, northwestern Pennsylvania, and northern Ohio, though it ranges from Maine and Quebec

to Michigan and south to Georgia and Arkansas.

Leaf and bark superficially resemble rock oak, though the two species actually have little in common. Bark on the younger branches peels off in large strips, giving the tree a rather unkempt appearance; on older trunks is dark gray, deeply fissured, and shows little tendency to scale off as does white oak. Lower branches often show a marked tendency to droop on open-grown trees.

The leaves are large, 6-8 inches long, deep olive green, densely white-woolly beneath (the contrast between upper and lower surfaces may have suggested specific name "bicolor"), with about 5-6 shallow scalloped lobes on either side; obovate in general outline; wedge-shaped at the base. Acorns frequently in clusters of 2-3 on long stalks (about 2 inches long); cups tend to be miniatures of those of bur oak; meat quite sweet. Twigs stout, yellowish to red brown, nearly or quite smooth, covered with pale raised lenticels; buds pale and chestnut brown, often slightly hairy at tips.

The wood in physical properties; and, therefore, in its uses, is very much like that of the white oak, except that it is both stronger and heavier than the latter.

ROCK OAK (Q. prinus)

Common in the mountainous regions of Pennsylvania, as well as other states of the Appalachians; locally it is the prevailing tree. Found on the driest and rockiest ridges, but grows best in the rich moist soil of coves and lower slopes. Possesses a distinct individuality; one of the easiest of our oaks to identify.

Sometimes called chestnut oak because the leaves of rock oak and chestnut bear a close general resemblance; in shape, color, and texture they agree closely, but the teeth or lobes on the edges of the rock oak leaf are blunt pointed; while those of chestnut, though of about the same size, are sharp pointed and each lobe is tipped with a bristle. Rock oak leaves are thick and stiff, 3-8 inches long and about one-half as wide; oblong in outline; primary veins prominent, each ending in a rounded lobe on the margin of the leaf; turn yellow or rusty brown in autumn before falling.

The acorn is a particularly lustrous chestnut-brown when mature, 3/4 to 1¼ inches long, oval, and immersed a third of its length in the thin cup that is roughened with small knobs; kernel sweet and edible. The acorns ripen the first autumn and start germinating soon

after they fall, even on a thick mat of leaves. Twigs slender, angular, orange brown in color, terminated by a cluster of yellowish-brown, sharp pointed buds.

Rock oak is a light-demanding tree; when not crowded it frequently grows crooked, forks close to the ground, and forms a very broad open crown. Its principal associates are chestnut, pitch pine, black locust, scarlet oak and black birch. Since the death of the chestnut it is one of the trees that is seeding into the openings and helping to fill the vacancies which it left. Commonly makes its growth in installments.

Bark on young trees smooth, or the fissures far apart - later it becomes deeply furrowed vertically; ridges very solid, sharp-angled, not scaly; frequently is 3 inches or more thick (on old trunks it is thicker and rougher than the bark of any other Pennsylvania oak). To the student of lichens, the bark of rock oak offers a rich field for invetigation.

Rock oak bark has long been valuable for tanning. There is tannin the bark of all oaks, and several species contain it in commercial quantities, but rock oak is more important to the leather industry than any other oak. In richness of tannin, the tanbark oak of California occupies

a high place, but it is not supplying as much material as the eastern tree. Hemlock bark is peeled in large quantities, but tanneries often mix rock oak bark with it to lighten the deep red color imparted to leather when hemlock bark is the sole material employed.

Years ago it was common practice to cut trees for the bark alone (as was true also of hemlock), the wood being left to rot in the woods; logs are now worth hauling to sawmills, unless in remote districts.

Rock oak is well-named, not simply because it grows in the rockiest places - for it sometimes occurs on fertile bottomlands - but because there is something about the tree which always suggests hardiness; its wood is hard and tough; form seldom graceful; the strong, though often crooked limbs, with angular curves, and firm, deeply-fissured bark, give it a decided roughness of exterior and convey the impression of sturdy strength - able to meet, resist and overcome the difficulties of its surroundings, and to mature its products of value to man on soils so poor that few other trees could exist thereon. It has the appearance of a very slow-growing tree, and so it usually is; however, when found on fertile soils, it is capable of making rather rapid growth for a representative of the white oak group.

THE BLACK OAK GROUP

What botanists call black oaks, speaking in the plural, lumbermen call red oaks. The difference is only a difference in name for the same group of trees. The general dark color of the bark suggests the name to botanists, while the red tint of the wood appeals more to the lumberman.

The trees of this group, embracing some 25 or more species in this country, all mature their acorns the second year, while the trees belonging to the white oak group ripen their's the first year. Most species of the black oak group have leaves with sharp-pointed lobes, ending in bristles; this helps to separate them from the white oaks but not from one another.

RED OAK (Q. rubra)

One of the largest and tallest of all the oaks; also generally conceded to make the fastest growth. A northern species - reaches as far north as Nova Scotia and southern New Brunswick, west through Quebec to eastern Minnesota, and south to Georgia and Texas. Its range overlaps in the south with the southern or Texan red oak.

Red oak is a well-groomed tree, a real gentleman of the forest. Every feature of the tree presents a clean,

smooth appearance.

The bark is characterized by shallow, perpendicular furrows; the ridges broad, smooth, flat-tipped, rather long and somewhat regularly set, the inner bark reddish-brown. The forest-grown tree disposes of its lower limbs early in life, and develops a long, smooth, invariably straight trunk, with a narrow crown. Probably on no other species of oak does the bark of the trunk and limbs continue smooth so long. Although the bark on all trees is rough at the base, the characteristic flat-topped ridges are usually retained higher upon the trunk; also, the straight, smooth branches are quite distinctive. The twigs are smooth and slender; buds smooth (scales sometimes have slightly pubescent margins), sharp-pointed, often constricted at the base.

Leaves oval to obovate in outline, average 8 by 5 inches, with many-pointed lobes, bristle-tipped, with very few subsidiary points; thin, not deeply notched, altogether smooth; in early spring deep red, in autumn turning a rich maroon-red. Usually the moderately long leaf-stalk and also the midrib are red-tinged above. In shape the leaf resembles one form of the black oak leaf, but the latter is more hairy and not so smooth and glossy.

The acorns too are distinctive. They are large and egg-shaped, with a shallow saucer-like cup covering but a small portion of their base. The cups are smooth, velvety

within, and the scales closely lapped. It requires two years for the acorns to mature; borne singly or in pairs on a short, thick stalk; are bitter, and only eaten by game when white oak acorns are not available. Red oak is a prolific seeder; it also sprouts from the stump quite freely. Prefers cool moist sites but will thrive on the driest slopes and ridges. It is one of the few broadleaf trees that is commonly grown in the State Forest nurseries of Pennsylvania. Often planted as an ornamental and makes an excellent shade tree in towns and cities. Has been widely distributed in Europe and foresters there hold it in high esteem.

Interest in red oak lumber is of comparatively recent date. Some red oak has always been used for various purposes, particularly rough lumber; while white oak was cheap and plentiful, sawmill men usually let red oak alone, but now they are glad to get it. The wood is lighter than white oak and generally regarded as possessing less strength and stiffness, nor are the medullary rays quite so broad or conspicuous. It is rather coarse grained, not durable when exposed to the weather or in contact with the ground; has large, open pores, plainly visible on a cross section. The open pores disqualify red oak for use in tight cooperage used somewhat for furniture, slack cooperage, construction,

interior finish of houses, and railroad ties, as well as for many other common uses.

BLACK OAK (Q. velutina)

This oak is one of the easiest to identify. The inner bark is yellow; the point of a knife easily reaches it, cutting through a deep crack in the bark, and no mistake is possible, for no other oak has this yellow layer of bark; formerly important as a source of yellow dye called "quercitron".

It has stout, angular twigs, often rusty-pubescent; in winter bearing large, acute, angular buds covered with many scales, densely coated with hairs. The buds of scarlet oak, with which it may be easily confused, are somewhat smaller, less angular, and only the tips are pubescent. The leaves, too, are quite distinctive, ordinarily being less deeply lobed than other species of the red oak group (variable, however); often covered with a scurfy pubescence, particularly on their lower surfaces. They are dark green amd sometimes glossy above, cut into about 3 lobes on each side, each terminating in 3 or more bristle-tipped points.

Black oak acorns are light brown, average less than an inch long, almost globular, with the top-shaped cup covering about half the nut. The peculiar shape of the

cup, as well as the long, coarse, hairy, rather loose scales that cover it and form a fringe along the margin are distinctive. Cutting open an acorn discloses the yellow kernel which is quite bitter and seldom eaten by animals.

The tree takes its common name from the bark which is usually dark in color, particularly on older trunks; often, however, the bark is so encrusted with lichens as to appear gray in color. The botanical name "velutina" undoubtedly refers to the "velvety" character of its twigs, buds, flowers and leaves; just as red oak is one of the smoothest of the black oak group, so black oak itself may be characterized as the most pubescent.

The black oak's range extends over nearly a million square miles; it exceeds the limits of most oaks in its geographical distribution. It is common on dry, gravelly uplands; prefers the foothills, and in Pennsylvania is seldom found on rocky slopes or ridges. Its wood is much like that of red oak and in general it finds the same uses.

SCARLET OAK (Q. coccinea)

Our most brilliant oak; the foliage in summer shining green, in autumn flaming scarlet. The leaves are

quite smooth on both surfaces, their general outline broadly ovate, often nearly square-cut at the base; very deeply divided into about 7 narrow lobes, each lobe with 3-5 points bristle-tipped; lobes separated by clefts that extend almost to the midrib. The leaves are rather persistent, and often cling on the twigs all winter.

In size, shape, and color, the fruit closely resembles that of black oak; the acorn cup, however, is covered with close-pressed, smooth, glossy, reddish-brown scales (those of black oak are rather loose and hairy); cup closely drawn in at the edge, covers about half of the nut; acorns bitter, mature in two seasons.

Scarlet oak twigs are smooth, usually more slender and not so prominently angled as are those of black oak; the buds too are more blunt-pointed and covered with pale hairs from apex to middle (black oak buds are sharp pointed, prominently angled, and entirely covered with a dense coating of hairs). On old trunks the bark is intermediate in roughness between red and black oak; is dark in color and broken into rough, irregular, deep fissures which separate ridges not so rough as those of the black oak and not so flat-topped as those of the red oak; inner bark reddish. The persistent, stunted, often drooping and dead

lateral branches are also peculiar to this tree - particularly true of trees growing in wet locations.

Observation throughout Pennsylvania justifies the statement that probably no other oak is so commonly misnamed by woodsmen and those not possessing a technical knowledge of trees, as is scarlet oak. It is most commonly called "pin oak". Although the two species have some points in common, nevertheless they are so distinctly different that once their characteristics are learned they need never be confused. Pin oak frequents moist, usually swampy locations; only occasionally will scarlet oak be found in such places, since it prefers well-drained soils and is most common on slopes and ridges in company with red and black oak. Then too, pin oak buds are much smaller and smoother than those of scarlet oak; its acorns are smaller and have much more shallow cups; its form, and also the short, stiff, pin-like twigs furnish additional distinguishing features.

Scarlet oak is particularly susceptible to heart rot after about 50 years of age; makes fast growth, however; the wood is of little commercial importance as compared with some of the other oaks; is sold on the market as red oak but is inferior in quality to the latter. On account of its fast growth, and brilliant foliage with special autumnal coloration, it is regarded as one of the most desirable

trees for street or park planting. However, the brilliancy of its foliage is seldom exhibited to as good advantage in cultivation as in the forest where contrasts are more numerous.

PIN OAK (Q. palustris)

Pin oak is a tree which prefers moist situations, such as wet woods, borders of swamps and river banks. It can and does sometimes occur naturally on high, dry ground, but it thrives best in cold boggy soils. The botanical name "palustris" refers to the tree's habit of growing in swamps and mucky land along streams. In choice of habitat it resembles swamp white oak and the two often occur together; both find their most congenial surroundings where the roots can readily reach water. However, pin oak is relatively restricted in its range, growing from Massachusetts south to the District of Columbia, and as far west as Kansas. It grows much larger west of the Alleghenies than east of them. The form of pin oak is quite distinctive. When growing in the open it develops a pyramidal shape of crown, with its topmost branches elevated, the middle ones more or less horizontal, and the lower markedly drooping and persistent. Only when found growing in dense stands does it prune itself well. Usually its lower branches

are dead, but hang in a tangled mass, almost touching the ground. "Pin" refers to the vast numbers of short, spiky, lateral twigs, with a thorny appearance; they leave the trunk and larger limbs at nearly right angles, and criss-cross in all directions, bristling outward at every angle. Such features give the tree a rather unkempt appearance; it has been aptly described as "a ragged denizen of abandoned swamp land".

Pin oak has decidedly small leaves, their surface area probably averaging less than any other commercial oak of the northeast. They are 3 to 5 inches long, very deeply cut, with 2 to 3 narrow lobes on either side, the sharp points bristle-tipped. Often they are about as broad as long, the general outline broad-ovate, lustrous green in summer, and turn a rich cardinal red in autumn. The slender twigs bear extremely small, smooth, brown buds in winter.

The fruit of pin oak is a tiny acorn which grows either sessile or on a very short stem; sometimes in clusters, often singly. In shape the acorns are nearly hemispherical, and usually measure less than a half-inch in diameter. They are enclosed only at the base, in a thin, saucer-shaped cup; the cup scales thin and flat, closely appressed; mature the second year; not edible; bitter.

The nuts often have conspicuous dark lines running from the apex to the base.

Mature trees have a hard, rough, dark-colored bark that shows no tendency to scale off; characterized by shallow furrows; frequently cracks open and shows the reddish inner layer. In spite of its high degree of strength, the wood is not in great favor; used mostly in construction; checks and warps badly in seasoning; because of numerous limbs, lumber cut from pin oak is usually knotty, and the percentage of good grades small. However, it is a rapid grower for an oak, only the red oak excelling it.

Oak-apples or galls are the round excrescences formed on the limbs by gall-flies and their eggs. They seem particularly fond of this species and specimens are often seen which are literally covered with them. The worms which live inside seem to flourish particularly well on the food they imbibe from pin oak. It is said that the primitive school teachers 3 or 4 generations ago turned these oak galls to account. They are rich in tannin, and were employed in manufacturing the local ink supply. The teachers were the ink makers as well as the pen cutters when the pens were whittled from quills. The process of making the ink was simple. The galls were soaked in a kettle

of water and nails. The iron acted on the tannin and produced the desired blackness, but if special luster was desired, it was furnished by adding the fruit of the wild green-brier (Smilax rotundifolia), which grew abundantly in the woods. It was well that steel pens were not then in use, for the schoolmaster's ink would have eaten up such a pen in a single day.

Pin oak has other redeeming qualities. It has proved to be a valuable street and park tree. It possesses several characteristics which recommend it for that use. It grows rapidly, and quickly attains a size which lessens its liability to injury by accidents. Its shade is tolerably dense; the crown is shapely and attractive; the leaves fall late; and it seems to withstand the smoke and dust of cities better than many other trees. It is easily and successfully transplanted if taken when small. Many towns and cities, from Long Island to Washington, D.C. have planted the pin oak along streets, avenues, and in parks. Several thoroughfares in Washington are shaded by them.

SCRUB OAK (Q. illicifolia)

Scrub oak is so named from its small size and scrubby appearance. It seldom grows taller than a man's head, though occasionally it attains the dimensions

of a small tree 20 to 25 feet high, with a trunk diameter of 6 to 10 inches. The stems lack sufficient size for use, except for fuel when large.

Occurs in dense thickets, sometimes almost impossible for a person to crawl through. Its figure is straggling, the stems crooked, and the branches spreading; resembles a shrub and barely deserves to be called a tree. Takes possession of areas that have been burned over repeatedly - the so-called "barrens" of various localities in Pennsylvania and elsewhere in the East. It sprouts and root suckers freely; produces enormous quantities of acorns at an early age. Once established, it is extremely difficult to eradicate; foresters have been experimenting for many years to discover some practical means of eliminating it from areas of which it has taken complete possession. Absolute fire protection which permits other species to over-top it seems to offer most promise of success in combatting this forest weed - to accomplish results, however, requires many years of painstaking vigilance.

The young twigs are gray-tomentose, bearing chestnut-brown buds with dark margined scales. Leaves obovate, usually 5-lobed; sinuses shallow; glossy dark green above, pale tomentose below; leathery. Some russet-

brown leaves usually persist all winter - the so-called "red brush" of the woodsman and a favorite haunt of the deer. The acorns are light brown with conspicuous dark lines running from the tip to the base; barely a half-inch long, pointed at the apex; about half covered by the top-shaped cup which has closely overlapped scales.

Scrub oak is most common on sandy barrens or poor rocky soils. It is distributed from Maine southward along the Appalachians to North Carolina; occurs also in the well-known pine barrens of southern New Jersey.

CLIMBING VINES

BITTERSWEET (Celastrus scandens)

A vigorous woody climber, twining upon itself in coils and snarls, over fences, walls and bushes to considerable distances, even ascending small trees to 15 or 20 feet. Although it grows in all kinds of soils, and in moist or dry places, bittersweet prefers a rich moist loam and a half shaded situation. It is rather frequent in waste places in almost all parts of Pennsylvania; ranges from Maine to Manitoba, south to North Carolina, Tennessee and New Mexico.

It has a smooth gray stem and the twigs show tough silvery filaments when broken. The alternate leaves are ovate-oblong in shape, 2 to 3½ inches long, pointed, fine-toothed, generally narrowed at the base, smooth above and beneath; appear two-ranked by the twisting of the stem. In winter the small, blunt, conical buds, and leaf scars containing one round vascular bundle, help to identify it. Its small greenish-white flowers are inconspicuous; occur in terminal racemes at the ends of the branchlets in May or early June; staminate and pistillate forms often on separate plants.

Almost everybody who lives in or visits rural

districts knows this vine by its showy fruit. The rounded orange capsules mature in autumn, finally breaking open by 3 valves, exposing a crimson-red pulp which surrounds 3 to 6 brown seeds; frequently persist through the winter. Although non-poisonous, the fruit seems distasteful to humans but is enjoyed by birds which scatter the seeds. In country homes it is in great demand for Christmas decorations. The fruiting branches may be cut in autumn and kept indoors all winter as dry bouquets; commercial collecting, with that of autoists, threaten to exterminate the plant in many localities.

Bittersweet is frequently used for ornamental planting because of its pleasing yellow-green foliage, and its clusters of persistent showy fruits. It suckers freely and grows so dense that it is a favorite for covering trellis-work, porches, fences, rocks and walls. However, it should not be permitted to twine about ornamental trees as it will injure or strangle them by constriction; often it twists about other stems so closely as to deform them in curious ways. Both the bark and fruit were formerly used in medicine and for compounding home remedies destined to cleanse the blood and act upon a torpid liver.

GREEN BRIER (Smilax sp.)

Throughout eastern United States, every hunter, fisherman, and woodsman worthy of the name has, through frequent contacts and possibly painful experience, learned to know and respect these common woodland briers. A number of different species are found in Pennsylvania, but all have certain characteristics in common.

The green briers are perennial woody vines, usually well armed throughout with short stout thorns. They climb by means of tandrils, two of which are found at the base of many leaf-stalks. The usually oval, entire-margined leaves are alternate, simple; smooth and leathery; net-veined, with prominent primary veins radiating from the base. Few persons notice the small greenish flowers, occurring in umbels about mid-summer; in autumn, however, the bluish-black, nearly dry, berries, with a purplish bloom, about the size of buckshot, are rather conspicuous. Also, the more common species have light green angular stems which furnish a simple means of identification in all seasons of the year.

Other common names by which they are known include cat brier and saw brier, both descriptive of the painful scratches, not to mention torn clothing, that a person can experience from contact with them. Their root-stocks run for long distances, just under the surface

of the ground. The vines themselves may sometimes attain 40 feet in length.

WILD GRAPE (Vitis sp.)

Few people fail to recognize wild grape, even though they may be unable to differentiate between the several species common to Pennsylvania. Its appearance and habit of growth differs but little from the cultivated grape, which is but natural to expect when one realizes that most of the grapes cultivated in eastern America have been produced within a century from wild American species.

Wild grapes are woody vines (rarely shrubby), with loose shreddy bark; trailing or climbing by coiling tendrils - often reaching like cables into the branches of tall trees. They are found most commonly in moist thickets and waste places, often in open woods.

The leaves are simple, usually palmately lobed and variously toothed, rounded to heart-shaped, with long stout peticles. The small, yellow-green, fragrant flowers occur in panicled clusters; often staminate (male) and pistillate (female) flowers occur

on separate plants. Fruit a rounded edible berry; few-seeded and pulpy; fragrant; seeds with a beak-like base.

The tendrils of wild grape are quite interesting. In the first place, botanists know that they are modified forms of leaf, leaf-stem, branch or stipule. Until they find a support they are in constant motion; failing to catch hold of anything they gradually wither and die. When a tendril feels a support it stiffens and clings; at the same time it throws its entire straight length into a spiral - in that form it can better withstand a sudden strain, as can the twisted cable that holds a ship to its anchorage. Moreover, it is a double spiral - near the middle the direction of the curve is reversed.

The three wild species of grape native to Pennsylvania may be distinguished as follows:-

1. Leaves densely rusty - woolly on under side; fruit smaller .... Fox Grape (Vitis labrusca)

1. Leaves not densely rusty or woolly on under side; fruit smaller 2

2. Leaves whitish below; tufted hairs in axles of veins .... Pigeon Grape (V. aestivalis)

2. Leaves green both sides; floccose hairs below; independent of veins .... Chicken Grape (V. cordifolia)

The grape was early domesticated on account of its edible fruit and its history is as old as man himself. When the first settlers came to America they brought with them their native grape, but it was not the success here it was at home. Therefore attention was early directed to the improvement of our native species. This work has continued until we now have hundreds of horticultural varieties of grapes, obtained by crossing our native species. Grapes are easily propagated by layering, grafting and cutting - the last named method is the popular one and is most easily and successfully done.

(c) Protection of Forests from Fire is the foundation of forest management. Although the lumberman's axe left the forest in miserable shape, it at least did not destroy the forest cover and forest soil, and remove completely the chance of valuable species from some natural regeneration, as repeated forest fires have done. Fires do not only injure or destroy the wood crop - most completely in the seedling period - but they destroy all potential social services that the forest yields - water regulation; control of erosion; silting of reservoirs,

streams and agricultural lands; hunting, fishing and recreation; and even health values. And worst of all they deprive a large number of people from earning a living in the needed forest industries.

The land demands of the nation have been completely changed in the last 50 years. The early demand and need of increasing the cleared land for agriculture and grazing led to the feeling that the forest was a hindrance to human development. It could be destroyed with impunity. Today the surplus crops and range animals and the increasing distance of lumber transportation, and the local growing scarcity of high quality timber show that forest destruction and the clearing of steep, rough and poor quality soils for impossible cultivation have gone entirely too far. These lands should grow forest trees. But reforestation is a foolish waste if the effort is to be burned up this year or next, or the next. To grow a crop of trees is a long time and tedious process and the time factor alone is a serious obstacle to private owners investing in reforested land. Add the forest fire risk and private reforestation becomes more than doubtful in many parts of the country, including much of Pennsylvania, unless we can make more rapid headway in forest fire reduction.

The first line of attack is <u>prevention</u> of forest fires. This must be accomplished by presenting the acute reforestation need to the people through appeal to special groups interested in special forest benefits. This appeal must go to the forest camper, the recreationist, hunter, fisherman, the people desiring good drinking water, cheaper water power, relief from floods, more work in forest industries, desiring cheaper wood supplies, and tax paying lands instead of tax delinquent lands to help carry the burden of schools, roads, poor relief and local government costs. Educational effort against fires in the forest might well begin in children's pre-school stories, be kept up through our public school education system, and be presented to the mature public through picture, radio, and platform agencies. We are changing the inherited point of view of a nation. The effort involved must be put forth accordingly. Tremendous progress has been made in 30 years along with developing national and state forestry organizations. This progress should now be doubled in the next 10 years with these organizations functioning.

After wilful forest burning is stamped out by public conviction that it is a great social evil and that "Everybody loses when forests burn," there still will

remain a smaller number of forest fires starting by lightning and accidents or carelessness.

In spite of the fire prevention campaign of the State, Pennsylvania has had an average of about 3,100 forest fires per year for 1921 to 1931. The detection and fire fighting organization has still a heavy responsibility to the people of the State.

The second step in combatting forest fires after the prevention effort is prompt detection of fires that do occur. A few men can put out a small fire early discovered, where it may take a hundred men a few hours later when the fire has grown to large size and caused tremendous loss.

To detect fires early Pennsylvania has built over 115 fire towers (generally of steel), equipped with cabins, range finders, telephone connections, and manned by fire observers during the spring and fall fire seasons. These cover state and private lands equally. Of the 800 fire observation stations maintained by all the States with Federal assistamnce, Pennsylvania has over one seventh.

A second adjunct to fire suppression is the road and trail system which permits fire-crews to reach a

fire by automobile and truck in a few minutes. Under the discussion of forest roads and trails this has been made plain. The State Forest lands are being opened up to rapid transportation. They already have over 2,200 miles of forest roads and 2,800 miles of trails. If private forest lands were equally as well equipped for rapid forest fire/loss would be much less. attack the fire

The acreages fire losses on Pennsylvania state forest lands have been reduced as follows:

Years	Percentage of State forest burned over
1913	7.21
1914-16	2.32
1917-19	1.28
1920-22	1.17
1923-25	.60
1926-28	.34
1929	.01

In 1930 and 1931 these figures bounded upward due largely to the excessive drought. In the spring of 1933 the fire loss has been the lowest on record for the state. The losses on private lands, due to poor roads, and no resident forest employees, are

larger than on state lands.

In addition to towers, telephones and roads and trails, fire fighting crews must be organized in advance and equipped with axes, brush hooks, back-fire torches, special fire rakes, knapsack water tanks and pumps, as well as truck or auto transportation. In some cases power pumps and long hose lines are used to advantage.

And back of all this equipment must be faithful and public spirited foresters, rangers, inspectors, fire wardens, and fire-crew members. These men must be backed by the public demand that the forest fire evil must be reduced to the point where forest fire insurance companies will carry the risk for the private owner at rates comparable with furniture and buildings. Then and then only will private reforestation be in a position to forge ahead on a safe business basis.

The forest fire evil has been much earlier appreciated by the national government than many of the state governments. Accordingly to stimulate backward states and forest land owners, the federal government in 1911 under the "Weeks Law" began the policy of federal appropriation for the fire protection to the states in cooperation with state and private effort.

This has resulted in the establishment of state forestry organizations in many states (particularly the south) where none would be otherwise supported. The south has 16 thousand or 40% of the 40 thousand fires burning annually (1926-30 average) in the United States. The Middle Atlantic States are next with almost 7,000 of which Pennsylvania furnishes 3,000 (1921-31 average).

The expenditure per acre for fire protection on state and private forest land is about 2.8 cents per acre in the Middle Atlantic states and the area burned is still at least 3 times too high (according to the U.S.F.S. Copeland Report).

The average area of forest burned in Pennsylvania from 1922-31 is over 180,000 acres or 1.4 percent of the total forested area. The loss on state lands only is not over half of this as given in earlier table. The average cost of extinction has been $174,000. for the same period or 1.3 cents per acre for our 13 million acres of forest. The average loss has been estimated at $547,000. which is $3.00 per acre burned, or 4.2 cents per acre of forest in the state. The fire loss estimate is undoubtedly far too low if the social service values of the forest such as water-shed cover, recreation, soil deterioration, etc., are

added to the wood loss.

Surely our forest fire evil needs continued and increased effort in its elimination. "Everybody loses when the forest burns."

(d) Question period - identification of specimens brought in by the men.

(e) Field Trip. Establish a hypothetical fire on a slope. Demonstrate fire line location, beginning in front of "header", demonstrate splitting of crew, working in opposite directions - and down slope. Show how the fire line should go straight down slope or cut in. If the line bends out and away from the fire, the back-fire is constantly drawing up slope and over the cut line toward unburned material. This makes a break-over easy, and hard work for the guards. Point out the use of roads for backfiring on a stormy day; also the method of locating a back-fire line just over a sharp ridge away from the wind, using the slope to run back your back-fire against the wind, which on top of the ridge would hold the back-fire from widening the safety strip.

Have ranger present with tools for 1 fire-crew for the demonstration.

Lesson 4 (a) Units and methods of measurement in forestry.

In forestry discussion it is necessary to use special units of measure for describing the quantity of wood or lumber on a given area of forest land, as well as to measure the rate of growth of trees and forest stands. It is these same units that are used in buying and selling wood, timber and lumber. The units used are generally units of volume and not units of weight.

In buying or selling fuel wood the most common unit is the "cord". A "cord", we recall, is a stack or pile of wood 4 ft. wide, 4 ft. high and 8 ft. long, containing 128 cubic feet of stacked material. The solid wood in a cord depends on the straightness of the pieces, their diameter, length, and whether round or split. The solid contents may vary from 70 to 100 cubic feet. The straighter the pieces, the larger their diameter, or the shorter their length, the larger the solid wood volume in a cord. As an average largely applied to coniferous timber 3 inches and over in diameter, the custom is to figure 90 solid cu. ft. of wood to the 128 feet stacked cord. It should be noted that in some localities where fire-wood is sold in stove lengths, the seller often means by a "cord" a rick of wood 1 stove-length wide (about 16 inches) and 4 ft. high and 8 ft. long. This is really

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only a third of a standard "cord". On the other hand many pulp and chemical companies demand that the "cord" shall consist of 5 ft. wood, ranked 4 ft. high and 8 ft. long, sometimes called the "long cord". It contains a fourth more than the standard cord. In buying or selling wood be sure to have your "cord" fully described in the agreement.

Bark for tanning, and anthracite mine timber is often sold by the ton (weight). This is better in figuring freight costs only, as a cord or a thousand board feet of lumber or logs is quite variable in weight depending on its dryness, as well as the species of wood. Locust, hickory and oak are very heavy woods. White pine, cedar, cottonwood and basswood are very light woods.

But for logs intended for lumber or veneer, and for lumber itself the unit of measure is a <u>board foot</u> - that is, a board an inch thick and containing a square foot of surface. The "board foot" contents of a piece of lumber is secured by multiplying its length in feet by its width and thickness in inches and dividing by 12. A 2"x 4" (2 in. x 4 in.) scantling 12 feet long contains 8 bd. ft. a 3 in. plank 10 inches wide and 16 ft. long contains 40 bd. ft. From its use for sawed lumber, this "board foot" unit came to be applied to round logs and standing

timber as a measure not of the solid wood contents of the logs but as the squared lumber that could be cut from the logs and trees. Tables giving the amount of product that can be cut from logs, arranged according to their diameter and length are termed "log rules."

The oldest log rule is the "Doyle Rule", which deducts 4 inches from the log diameter in inches (small and inside bark) squares the remainder, multiplies by the length in feet and divides by 12. This rule gave satisfactory values as long as the logs averaged large in diameter (20 to 28 inches), and for circular saws. For small logs it is too low, and for band saws it is too low. It is too low for logs over 30 inches.

The U.S.F.S. uses the "Scribner decimal" rule giving the log contents in bd. ft. rounded in tens. All rules require scalers deductions for unsoundness and crooked logs.

Roughly 2 cords are figured equal to 1,000 bd. ft. in log volume. The scale runs higher for large straight logs and lower for small material. The amount by which the mill cut exceeds the log scale of logs is called the "over-run."

Since "cord" and "board feet" units are

variable in their solid wood volumes, the forester uses cu. ft. (solid) as his standard of measure in his study of forest growth.

To assist in estimating the volume of standing timber, numbers of trees that have been cut for wood products are measured up and their volumes determined in cu. ft., cords, or board feet (larger timber only) or piece products. The diameters of the trees at 4.5 ft. from the ground (D.B.H.) and their heights or number of logs are taken. The tree volumes are then sorted into diameter and height (or no. of logs) classes and average values gotten. These average values are then arranged in the form of a table called a volume table giving the average contents of trees of different diameters and heights.

The unit of forest land measure is of course the"acre", containing 160 sq. rds. or 10 sq. chains. If laid out as a square it measures 208.7 ft. on the side. In estimating timber, foresters generally measure a "strip acre" with a surveyors "chain" (66 ft. or 4 rd. long), taking a strip 1 chain wide and 10 chains long. By measuring the trees on these strips, placed 5,10, or 20 chains apart across a piece of forest land the wood volume on 20, 10 or 5 percent of the land is measured.

The more variable the forest the nearer together should be the lines. The cu. ft, or bd. ft. stand (volume) is gotten for the entire tract (100%) by multiplying by the proper factor - a 20% survey, multiply by 5, etc. If the tract has sharply different kinds of timber or different sizes (age classes) of trees on different parts, each part is strip surveyed and figures separately. All strips are measured across (rt. angles) the drainage.

There are other methods of ocular timber estimating or "cruising". These generally require pacing distances and counting trees or logs on some calculated plot as a circular quarter acre, and then multiplying by the contents of the average tree or log. It is important that these ocular plots be distributed systematically over the tract for a correct average.

Many kinds of forest products are sold by the "piece", instead of by the cord, or thousand board feet. Poles, posts, mine props, ties are sold by the piece, while lath and shingles are sold by the thousand pieces.

It is important that forest land owners and citizens in general be familiar with wood and timber measure units. Only as our people become familiar with forest land, and its trees as a wood crop, will they place the proper value on young tree growth which they now

too often designate as "brush", and make no effort to protect from fire, cattle disease or other injuries. Forest land has a production value, just as farm land has. It is frequently of lower value, until the tree crop adds a larger value before cutting time. There is more forest land to be valued, bought and sold, in Pennsylvania than cultivated farm land. This empire of 15 million (including 2 million in need of forest planting) acres is a natural resource capable of great expansion in value. It can furnish a living income for tens of thousand of workers and their families, particularly when combined with small agricultural properties, each furnishing a quota of income.

(b) Tree and Shrub Identification.

Broadleaf, simple, alternate-leaved trees and shrubs (continued); birches, beech, basswood; shrubs - hazelnut and alder.

THE BIRCHES (Betula Sp.)

There are 5 species of birch native to Pennsylvania, namely black, yellow, red, gray and paper birch. They all derive their common names from some characteristic of their respective barks, particularly its color and texture. Their bark is tight, scaly or separating into very thin papery plates and peeling off transversely. The leaves are simple, alternate, borne singly or in pairs on the branches but never opposite each other. Two types of twigs occur, namely "short spurs" with leaves more or less clustered, and "elongating shoots" with leaves borne singly. In winter the usually sharp buds, slender twigs, the presence of staminate catkins and old cones (strobiles), also the bark features are most prominent "ear marks" of the birches. All of the birches, especially the horticultural forms, are used more or less for ornamental planting. They are

beautiful trees but most species are short-lived. Their winged seeds are very small and light. Invariably the wood is dense and hard, diffuse-porous, reddish-brown in color (seasoned with difficulty), and sometimes possesses a highly prized curly or wavy figure.

BLACK BIRCH (Betula lenta)

Black birch bark is distinctive, both that of the slender twigs and also the trunks of young and older trees. One year old twigs have smooth, shiny, reddish brown bark with a strong wintergreen flavor. This pleasing aromatic taste has caused the tree to become well known to every country dweller throughout its range and always identified it. Also, the twigs, small branches and bark are often distilled for the essential oil they contain, which after further preparation is sold as "oil of wintergreen". On the trunks of young trees the bark is dark colored (hence the common name "black" birch), is very close fitting, smooth, and covered with prominent horizontally-elongated lenticels; its close resemblance to wild black cherry bark has caused the tree to be called "cherry birch" in some sections. On older trunks the bark is quite rough and broken into large, thick, irregular plates.

Black birch leaves somewhat resemble those of

yellow birch, but are smoother and, although finely toothed, rarely show doubly serrate as do those of the latter. They are pointed-ovate, bright green above, lighter beneath and smooth except on the veins, more or less heart-shaped at the base, and sharp pointed. The pistillate (female) catkins are cylindrical, stout, erect, and stemless, 1 to 1½ inches long, with smooth scales (not downy as in yellow birch), and are produced only once in every 3 or 4 years. The staminate (male) catkins are formed in clusters of usually 3 in the fall, each about 3/4 of an inch long, and elongate to 2 or 3 inches the following spring.

Of our five native birches, black birch is probably the most common and generally known species in Pennsylvania. It has some characteristics which cause it to stand out quite distinct from the others; the twigs of none are so smooth or have such a pronounced wintergreen flavor (Yellow birch only slightly); its bark is much darker and is not shed in papery rolls and flakes as on its kindred; and, excepting gray birch, its range is the most restricted of all. It shows a particular liking for the mountains although preferring the rich soil of coves, lower slopes, and stream banks, it is not uncommon to find it on rocky slopes and ridge tops. Except in Ontario and the vicinity of the

Great Lakes, black birch is rare or absent west of the Appalachians.

YELLOW BIRCH (Betula lutea)

Yellow birch is one of our most common hardwood trees in northern Pennsylvania and in cool moist ravines elsewhere. It occurs in southeastern Canada, New England, the Lake States, and south along the Appalachians as far as eastern Tennessee and North Carolina. Possibly the heaviest stands occur in the Lake States - Michigan, Wisconsin, and Minnesota. Its forest companions are black cherry, white ash, maple, tulip, basswood, black birch, beech, and it is frequently found growing with hemlock and white pine. In northern New England and the Adirondacks, yellow birch grows abundantly with red and black spruce and balsam fir.

Although possessing distinctive characteristics, the tree might easily be confused with black birch. Its leaves resemble those of black birch but a comparison shows the margins to be more distinctly double-toothed. The young twigs, too, appear to be paler and are slightly hairy; they have only to a faint degree the characteristic aromatic flavor of the black birch. Its more closely appressed buds and cone-like fruit more cylindrical and with hairy scales offer

additional points of distinction between the two species.

Yellow birch is named from the color of its bark. However, like black birch, and indeed almost any other forest tree, the bark of young and middle aged yellow birches shows little resemblance to that borne on mature individuals. One may easily note three distinct stages in its appearance. On young trunks and branches it is smooth, shining, light yellow with a satiny sheen; shows almost no early tendency to curl or shred, or if so the shreds are small, thin and papery. Later it becomes more gray and tends to peel off and curl transversely around the stem in thicker, larger flakes (very useful to hunters and campers in starting fires in wet weather). On mature trees the bark becomes darker, and tends to crack into thick plates, in such a manner as to much resemble black birch; veteran black and yellow birches are not easy to distinguish by bark alone.

It is an abundant seeder, and the seeds are light, winged, and scattered by the wind over long distances. The seeds will germinate without touching mineral soil, and take root quickly and grow vigorously. Young trees often develop on old rotten logs; frequently, as the log decays, the trees remain and grow to maturity on spreading, stilt-like roots. Or occasionally the seed find lodgment in the moss on top of a large rock; the roots descend the sides until they

reach the ground and, as the rock does not decay, the tree makes the most of the situation and may grow to a considerable size perched up on the rock.

All birches are subject to quick decay if conditions are right to produce it. When a yellow birch dies the wood falls to pieces so quickly that the bark may remain intact like a hollow shell, with little inside except powder of decayed wood. Although the wood is hard and strong, its non-durable character, together with a tendency to warp and check in seasoning, have given the tree a bad reputation. Early lumbermen frequently left yellow birch standing in the woods when they cut the timber which grew with it.

The wood is used mainly for flooring, furniture and interior finish, veneers for panels and seats, boxes, whell-hubs, spools, and woodenware. Birch broom handles have been a commodity since the first lathe went to work on that product; they are made of all the commercial birches, but yellow birch contributes a large part; other handles, such as are fitted to hand saws, planes, drawing knives, and augers, are also manufactured from yellow birch.

PAPER BIRCH (Betula papyrifera)

Paper birch is one of the best known and most

beautiful of our American trees. It is a northern species, reaching its best development in the states bordering on the Canadian line. Being one of our few transcontinental species, it extends from Newfoundland to the coast of Alaska, and south to southern Pennsylvania, Michigan, Montana and northwestern Washington. It occurs on the borders of lakes, swamps and streams, frequently in mixture with other hardwoods, and sometimes with evergreens. Because of its wide distribution, the tree exhibits great variation in size.

Undoubtedly the bark is the most distinctive feature of the tree. It is chalky to creamy white, peeling off in thin film-like strips which are tinged with yellow the color deepening inward with each successive layer; conspicuously marked with horizontally-elongated lenticels. Its smoothly-rounded, white columnar trunk has caused this tree to be generally known as "the lady of the woods". At the bases of the branches are brown patches, not so dark colored or triangular shaped, however, as on the gray birch. It is this layered, paper thin bark that gives rise to the common name "paper birch".

The bark of paper birch has played an important part in American history, story, and poetry. It was the canoe material, the roof, and the utensil in its region; serving for tents and the roofs of cabins, baskets and boxes

in which to store or carry food, as well as beds on which to sleep and wrapping material for bundles. Even today large quantities are gathered for making souvenir articles, a practice that is most destructive of tree beauty, for when once removed from living trees the bark is not renewed.

Aside from its white bark, paper birch may be recognized by its broadly oval leaves, firm in texture, and less narrowly pointed than those of the gray birch; young twigs woolly, roughened by grayish raised lenticels, and with resinous buds; also, the cone-like fruit spikes are usually drooping instead of erect as in other birches. In shape, the leaves of paper birch bear a striking resemblance to the Indian arrow head; being keen observers and imitators, it is entirely possible that the redmen fashioned their flint to resemble the leaf of this tree with which they were so familiar.

Long before explorers and venturesome fur traders had penetrated the wilderness, the Indians had brought the art of canoe making to perfection. They found the bark of paper birch to be very tough, strong and durable. Aside from that fact, its resinous character made it water-proof, and it could be stripped from the trees in large pieces. The Indians sewed pieces of bark together, using the long, slender

roots of tamarack for thread. The bark was stretched and tied over a frame, the shape of the canoe, and made of northern white cedar or some other light wood. Holes in the bark, and the partings at the seams, were stopped with resin from balsam fir, wax from balm of Gilead, or resin from pine. The forest supplied all the material needed by the Indian, and a canoe thus made, and large enough to carry 800 or 1,000 pounds, weighed no more than fifty pounds. Frail as it seemed, it was good for long service on rivers and lakes, and could weather storms of no small severity. It was only natural that this use of its bark should cause the tree to be called "canoe birch".

Destructive forest fires have raged over a considerable portion of the range of paper birch. Two characteristics of the tree - its light winged seeds and the fact that it cannot endure shade- enabled it to compete with aspen in taking possession of such burned areas. Although indefinitely known, its present available stumpage no doubt exceeds that of any other single species of birch in America.

The largest modern use of paper birch is for spools, the common kind for thread; only white sapwood, which makes up a major portion of the tree, is accepted by makers of spools. Tooth picks, broom handles, shoe pegs, and shoe

shanks are other important commodities from this tree; the wood is also made into excelsior, and to some extent used for pulp, turnery, veneers and fuel.

GRAY BIRCH (Betula populifolia)

Gray birch is chiefly confined to northeastern United States, growing from Nova Scotia west to the southern shores of Lake Ontario, thence south on the Atlantic coast to Delaware, and along mountain ranges to West Virginia. It is known also as white birch, old-field birch, poverty birch, and small white birch; the names describe either the habits or the appearance of the tree.

The bark is the most prominent feature of a thicket of these graceful but practically worthless little birches. On very young trees it is a golden yellow, later becoming grayish white; is close-fitting, not easily separable into layers; prominently marked with elongated lenticels, also black triangular patches beneath the junction of the branches; inner bark pale orange.

It is called an old-field species because it quickly scatters its small, winged seeds over abandoned farmland and takes possession when it does not have to compete with stronger species; once established, it is

difficult to eradicate as it sprouts and root-suckers quite readily. Poverty bi ch is an allusion, either to the poor waste ground it occupies, or the unpromising nature of the tree itself. It is rarely more than 20 or 30 feet in height, seldom forked, but with the stem generally clothed with branches nearly to the ground. In Pennsylvania and West Virginia the tree may be found on rocky slopes and even the crests of mountains.

The only native tree with which this one might be confused is the paper or canoe birch, but it is a relatively easy matter to distinguish these two white-barked trees from each other. Gray birch leaves are more triangular in outline, with acuminate tips, and the upper surface is highly varnished; its twigs with raised lenticels are rougher than those of any other birch; the slender, pendulous pollen-bearing catkins are usually solitary on the ends of the twigs; then too, the habit of growing in clumps, and also the black triangular blotches on its trunk are very typical features of gray birch. In addition, the foliage mass of gray birch is much thinner and more restless than that of paper birch. It is this latter feature of the tree which accounts for the common name poplar birch, also its scientific name, Betula populifolia; both are appropriate, for with every little breeze its leaves tremble and quake, as do those

of poplars and aspens.

Gray birch springs up quickly, grows with fair rapidity, but is short-lived. Like trembling aspen, it protects the ground and furnishes shelter for more valuable species which come later. The wood is somewhat soft, close-grained, but not strong or durable, and pale brown with nearly white sapwood. It is used principally for the manufacture of spools, shoe pegs, wood pulp, and barrel hoops, and for fuel. Recently it has become popular for rustic furniture and for decorating booths at public exhibits. The tree makes a very pretty ornamental when transplanted on lawns and in public parks.

RED BIRCH (Betula nigra)

The red birch is more appropriately called river birch, for in company with sycamore it always occurs on the borders of streams, ponds and marshes, although seldom found along headwaters. It is a comparatively southern species, being distributed from southern New Hampshire south along the Atlantic coast to Florida, and westward along the Gulf as far as Texas. Its largest size and best development are attained in the South Atlantic States and lower Mississippi basin, in which regions no other native birches are found.

Red birch could scarcely be confused with any other tree; its environment and characteristics portray its individuality. A favorite attitude of the tree is to lean over a river or pond, with the long graceful limbs almost touching the water. Few native trees present such a ragged, disheveled bark; it is salmon-red in color, peeling easily from the trunk and larger branches in curling papery layers; on old trees deeply furrowed perpendicularly, and broken into plate-like scales. The twigs are slender, reddish brown, pubescent, and not aromatic.

Its attractive dark foliage rather emphasizes the picturesque character of this birch. The leaves are triangular in outline, with broad wedge-shaped bases, distinctly double-toothed, glossy green above and whitish downy beneath (including the stems), particularly so when young. Pollen-bearing catkins appear in early spring as long festoons from the tips of the more thrifty twigs, two or three of the catkins generally hanging side by side. The pistillate catkins are short-stemmed, soft, downy, stout, and stand erect along the sides of the twigs.

Nature seems to recognize the tree's habit of hanging over muddy banks and has prepared it for that manner of life. Accordingly, the seeds ripen early in summer before

any of the other birches and when the rivers are falling. They are scattered by myriads on the muddy shore and upon the water. Those which fall in the mud find at once a suitable place for germination, and those whose fortune it is to drop in the water float away with the current, while others are driven by the wind until they lodge along the shores. Before the autumn or early winter high water comes they are well-rooted in the mud and sand, ready to put up a fight for their lives. The provision is a wise one. If the seeds matured in the fall, when low water is usual, they would be strewn along the shore line, and before they could take root and establish themselves, the high water and the ice of winter would destroy them. The seeds need mud to give them a start in life, and they need that start early in summer.

Red birches, standing as they do along water-courses, are forced to struggle with swollen streams laden with debris and floating ice. Hence it is common to see trees, or whole clumps of them, ornamented with clinging bits of driftwood and other rubbish left by the receding waters. Nor do they always escape injury, though their trunks are strong and pliant. The roots help to bind the soil in place on river banks, thus protecting fertile adjacent fields from serious damage by raging torrents. Then too,

by occupying waste ground that is too rough or marshy, or otherwise unsuited to agriculture, red birch becomes a tree of considerable economic value in any land economy program. It produces a wood that is light, but rather close-grained, strong, and useful for furniture, woodenware, and turned articles.

BEECH (Fagus grandifolia)

There is but one species of beech in North America and it is so well known and has such distinctive characteristics that it could hardly be confused with any other native tree. It ranges from Nova Scotia west to Ontario and northern Minnesota, thence south to Florida and Texas. Although common on rich uplands and moist rocky ground, our American beech prefers the rich lowlands, where it may send its roots down into moist, nutriment-laden soil. Like chestnut, pitch pine, and a number of other native trees, beech is rarely found on limestone soils. It usually grows in mixed forests of hardwoods, but is often found in the immediate presence of white pine, hemlock and spruce. Considerable areas are often occupied by little else; local names for such places are "beech woods", "beech ridge" and "beech flat". The tree is always known as beech in this country, although lumbermen may give it a qualifying word

such as red or white to designate differences in the color and character of the wood. Perhaps the finest examples of beech growth in the United States occur in the higher altitudes of the lower Appalachians, in eastern Tennessee and western North Carolina.

Beech is one of the truly beautiful trees of the forest; it is admired by many as much as the American elm or sugar maple. It produces a massive, smooth trunk, over-shadowed with a dense, spreading canopy of clean, graceful, taper-pointed twigs. In winter or summer, it is always finely groomed. An eye accustomed to the tree can recognize it at a distance by its mass of fine twigs outlined against the sky. Gray, a pure ashen-gray, is its color scheme throughout, when the leaves are off. In the open, beech shows a strong tendency to shorten in height and spread horizontally; it has been called the broadest tree of our fields, and the lower branches often elongate until from sheer weight the ends sweep the ground. While cattle seek the shade and shelter of such open-grown beeches, their trampling of the soil beneath often kills large trees, for the roots of a beech lie close to the surface.

Beech bark is easily recognized. It is very smooth, close fitting, light gray in color mottled with darker patches, and the fine delicate tracings of lickens

that cling to its surface. Few of our native trees retain a smooth bark throughout life; however, even on the oldest specimens of beech the trunk is seldom much cracked or roughened. But it does show a tendency to take on rounded vertical flutings which give character to an otherwise symmetrical bole. In dry weather there is no suggestion of life about the neutral-tinted trunk; but when a rain has moistened the surface, a vivid, living green is imparted to it. Such bark invites the cutting of initials and other outline carvings.

Its polished, zigzag twigs are adorned with long, conical, sharp-pointed buds - probably the longest buds of any American hardwood tree. The leaves vary from papery thin to leathery in texture, are sharp-pointed, ovate, and remarkably straight-veined; the unbranched veins terminate in rather remote but sharp teeth. Its perfect leaves are seldom spotted or eaten by insects; are deep green in summer, changing to a golden yellow in autumn. Another characteristic trait is shown in the flat leafy sprays, which give the foliage a conspicuously horizontal manner of growth. Many leaves persist on the branches through the greater part of the winter. Although a beech canopy casts a dense shade, its seedlings can thrive beneath it with so little sunlight that few herbaceous plants can exist there. Its abundant

leaf litter does much to enrich the forest soil.

The staminate flowers on long, silky, drooping stems appear in May along with the leaves. In the axils of the leaves occur the nut-producing flowers; they develop rapidly into a tiny bur with soft, spreading, recurved prickles. Following the first frost in autumn, each bur bursts into four sections; most of them remain clinging to the branches after the nuts have fallen. The nuts (two in each bur) are brown, shining, three-sided like a buckwheat grain, sweet and edible; they are small, but make up in delicious flavor what they lack in size; are highly prized by squirrels, chipmunks, ruffed grouse, wild turkeys, blue-jays, and other creatures of the forest. In former times those nuts formed a large part of the "mast" upon which wild pigeons fed, and for which the early settlers allowed their swine to roam the woods. Heavy seed crops appear to occur in 3 or 4 year cycles; the tree also sprouts and root suckers readily.

Beech wood is one of the heaviest and strongest of the common hardwoods. It gives long service when kept dry, but rots quickly in damp situations. Formerly beech was little used for lumber, but was long ago given an important place as firewood and material for charcoal. More recently it has been much in demand for flooring,

furniture, hardwood distillation, and such household articles as broom handles, woodenware, chairs, and brush-backs. The medullary rays are broad and prominent; they give quarter-sawed lumber a beautiful luster.

BASSWOOD (Tilia americana)

Basswood is a tree identified by its leaves, buds, flowers and fruit. No other native hardwood produces both unsymmetrical buds and leaves. Its buds are usually deep red in color, though occasionally greenish, with 3 visible scales, one of which is larger than the others and gives each bud a lopsided appearance. The leaves are obliquely heart-shaped, coarsely toothed, and the two sides differ greatly in size, that nearest the twig or branch being almost always the larger.

About June the small, starry white flowers appear, usually in great abundance. Often called bee-tree because basswood flowers are sweet-scented and secrete nectar. They attract bees in such numbers that the trees are fairly swarming with them. Basswood honey has a color and quality of flavor that has made it famous. From antiquity the fragrant flowers have been noted as bee pastures; the limes of classical history and mythology are

in reality basswoods, called lindens in European countries. In central Europe forests of basswood are still maintained for the honey which bees gather from the bloom; very large dimensions and great age are recorded there for the linden.

As the summer passes these flowers gradually develop into clusters of 4 or 5 rounded, nut-like, indehiscent drupes, each about the size of a pea. They hang together on a long stem, attached to the under side of a narrow leaf-like bract that serves somewhat as a parachute in their wind dispersal. Often the fruit persists on the tree until mid-winter or later. Each berry-like drupe has a hard woody outer covering and generally contains one, but sometimes two seeds within. It is a peculiar fact that they may remain in the ground for several years before finally germinating; the woody outer covering must soften and disintegrate before the embryo within can develop.

Basswood is so named from its bark, and the spelling was formerly bastwood, referring to the inner tough and fibrous part of the bark. This inner bark was used by pioneers for tying shocks of corn and other cordage purposes. Our American Indians made mats and ropes of it. The manufacture of articles from the bark was once a considerable industry, not so much in this country as in

Europe. However, some modern uses have been made of the bark in eastern United States. Chair bottoms are woven of it in lieu of cane and rattan, and thin narrow strips are likewise woven into baskets of coarse kinds.

The bark of basswood has characteristic external features that aid in identifying the tree, particularly in winter. It always has a grayish cast, and is firm, seldom scaling off. Young stems are quite smooth, but older trunks are scored perpendicularly with elongated fissures; the ridges confluent, narrow, flat-topped, and marked with transverse cracks. Its furrowed pattern somewhat resembles that of cucumber and tulip, with which basswood is often associated. Sapsuckers like to work on its back and horizontal rows of their regularly spaced drill holes are almost always present.

Basswood has a decided preference for rich, well-drained soil, and the best lumber is cut in fertile coves and flats, or on low land near streams. Most commonly it is associated with the Beech-Birch-Maple or so-called Northern Hardwood type of forest. The tree has a wide range, covering almost a million square miles, extending from New Brunswick to Manitoba and southward to Georgia and eastern Texas. The largest trees formerly grew in the forests of the lower Ohio valley, but few of the giants of former times are to be found

in that region now.

Basswood makes rapid growth, sprouts readily from the stump, will endure moderate shade, transplants fairly well, and its excellent form and valuable wood produced all contribute to make it an important timber tree for forestry purposes. Then too, its dense mass of dark green foliage, fragrant flowers, and relative freedom from insect and fungus attack have given it a prominent place in ornamental plantings for streets, parks and private estates. Certain horticultural varieties, mostly forms of the European linden, are occasionally utilized for landscaping, although our native species is much superior to any of these. However, its use as a street shade tree, particularly in cities, is no longer recommended as it cannot adapt itself to the smoke and dust and other undesirable city conditions.

The wood lends itself to a large and varied list of uses. It is diffuse porous, white, soft, light in weight, works easily, holds its shape well, and, considering its weight, is unusually difficult to split. It is practically odorless, hence is a desirable wood to contain food products. Among its principal uses are lumber, paper pulp, barrel heading, boxes, excelsior and veneer. This wood is the delight of wood carvers because of its whiteness, the ease with which it may be worked with tools, and its relative freedom from knots. Apiarists find no wood more suitable for the small,

light frames in which bees build the honey comb. It is found in such household articles as furniture, picture frames and yard sticks, as well as in ironing boards, trunks, pails, tubs, kegs and countless other things.

HAZELNUT (Corylus Sp.)

Two species of hazelnut, namely the American or common hazelnut (Corylus americana) and beaked hazelnut (Corylus rostrata) are native to Pennsylvania, as well as eastern and central United States; in fact, the latter species is transcontinental. Both are shrubs, rarely exceeding 8 feet in height, common in fence-rows and roadside thickets. Beaked hazelnut is the more common in mountainous districts. They bear a close general resemblance to each other. In Europe a related species, the European hazel (C. avellana) has been improved and brought into culture, furnishing the familiar filbert nut of commerce; it has been introduced into America.

No country boy needs to be informed concerning the good qualities of the fruit of hazelnut. The brown nuts mature in early autumn; they are rounded, about the size of a cherry, and are inclosed in a leafy involucre or husk , consisting of two more or less united and enlarged bracts.

Surrounding the kernel is a shell, somewhat harder than that of a chestnut, but which can with some difficulty, be cracked between the teeth. Although small, the kernel is very sweet and tasty. The nuts are particularly in demand around Christmas time; both of our native species supply commercial quantities. Many country people gather their own supply and store them away for winter as they do walnuts and butternuts. The nut varies much in quality and size, the best being nearly as large as the ordinary market filberts and of quite as agreeable flavor. Without doubt the best of these will some day be brought into civilization and probably improved as the European species has been.

Hazelnut bushes are usually small and clustered, owing to a tendency to throw up suckers from the base. In winter the hairy twigs and staminate catkins are helpful means of identification. In early spring these catkins develop into long, yellow, pollen-covered tassels that are quite conspicuous. The leaves closely resemble those of the birches, with which hazelnut is a near relative. Sometimes these shrubs are confused with the witch hazel, described in Lesson 7; there is no occasion for this, however, other than the name. The two hazelnuts are readily distinguishable by the following key:-

Husks (composed of 2 bracts) united and prolonged into a beak, about twice the length of the nut; catkins sessile or nearly so; buds usually expose only 2 pairs of scales ...Beaked Hazelnut

Husks nearly distinct and not prolonged into a beak; catkins usually stalked; buds with more than 2 pairs of visible scales. American Hazelnut

BLACK ALDER (Alnus rugosa)

Black alder is a large shrub, usually 6 to 12 feet high but individual specimens may show the habit of small trees. It forms dense, shrubby clumps and thickets in wet woods, swamps, cold bogs, and along streams and ponds. Its botanical range extends from Massachusetts to Florida, and westward to southern Minnesota and Texas; most common on the Atlantic coastal plain, southward also on the Piedmont plateau, rare and local west of the Appalachians.

Any trout fisherman worthy of the name needs no introduction to this plague that infests stream banks. If he has spent days scrambling through its tangled thickets, intent on keeping his tackle intact or to cast a fly on pools hidden beneath its inclining branches, it is very likely that he and black alder are not the best of friends. But its protection of the trout pools are a factor in maintaining good trout fishing.

This shrub has large, strong roots that throw up many suckers. It has a thin, smooth bark, dark colored with grayish blotches; yellow within; astringent: and fluted somewhat like the blue beech which it closely resembles. Because of its smooth bark it is frequently called smooth alder.

The leaves are oval or obovate, rather leathery, blunt pointed or rounded at the apex. When full grown they are dark green, smooth and glossy above; paler green, and usually pubescent on the veins beneath; with the straight, unbranched primary veins depressed above, ridged beneath, The under surface of the leaves is sufficiently glutinous to adhere to paper if pressure be applied. Their margins are set with short callous teeth. Black alder has a habit of shedding its leaves while they are yet green or slightly tinged with red.

In winter it is easily identified by the red buds that are conspicuously long-stalked, occurring on twigs prominently dotted with lenticels and containing a triangular greenish pith. Other equally helpful winter characteristics are the male catkins and persistent cone-like fruits. The staminate catkins are slender, cylindrical, stiff, in terminal clusters of 3-5; when mature in early spring they become drooping tassels loaded with pollen, appearing before

the leaves. The fruit is an ovoid, woody, cone-like strobile, about 1/2 inch long, composed of many hard, thickened scales; ripens in October, but, being persistent, the cones are usually present at all seasons. A fungus sometimes causes some of the cone scales to develop curled, tongue-like outgrowths, often an inch long.

Black alder is of little commercial importance because of its small size. However, it does act as a soil binder and in that way protects stream banks from washing away.

(c) Protection of Forests - Tree Diseases.

Although forest fires are by far the greatest scourge of the reforestation work as well as of standing mature timber, there are other evils that forest trees are heir to. Among these are plant diseases and insect enemies.

Our forest trees have generally built up more or less immunity to native plant diseases, but when a disease is introduced from a foreign country the results may be disastrous.

The causes of plant diseases generally fall in the lower orders of plant life, most frequently in the fungi, taken to include the slime molds, bacteria and true fungi. Only the parasite organisms cause serious damage to plants and trees. You will recall that the larger common examples of the true fungi include mushrooms, and fungi growing on dead wood. These are usually "saprophytic", living on dead organic matter. When they have the power to absorb living organic matter they are termed "parasitic".

Many of these fungi and related plants are minute organisms and therefore generally unnoticed except from their work. Those living on dead organic matter perform most valuable service. They "rot up" the fallen leaves, twigs, limbs and bark in the forest and return them to the soil to enrich it for new plant growth. If unused parts of trees and plants were not thus disposed of, our forests in a term of years would become knee-deep with inflammable material that would produce holocausts of fire if ignited in

dry and windy weather.

But an occasional fungus, bacteria, or mold is parasitic and there trouble begins for some plant or animal.

Perhaps the best example of a serious parasitic fungous tree disease is found in the chestnut blight (variously classified - now generally known as Endothia parasitica). This fungus develops from spores introduced in a wound made by insects, a shaded out limb or wind break. The roots (mycelium) of the fungus spread in all directions in the inner bark and cause a reddish, rounded spot of dead bark, or "canker". This canker increases until it girdles the limb or stem and finally kills the tree. This fungus disease was introduced probably in imports into New York, about 1900. It comes from China where Chinese and Japanese chestnut have developed great resistance to it. It has now spread from one end of the chestnut's range to the other - New England to Georgia, Ohio and Ontario. It has destroyed one of our best forest trees. If our chestnut develops effective immunity it will likely be so long in doing it that it will be of no practical benefit to our

reforestation work in the next 100 years.

The "mycelium" or inner bark threads of the fungus put out a reddish growth or "pustules" in the cracks of the bark. This tissue contains the winter spore sacs, each with 8 spores. These winter spores and the mycelium itself winters over to spread next year. Besides these, the fungus puts out through the pustules yellow horns of more minute summer spores in a much greater number. It is these, carried by the wind and insects, that carry the disease so rapidly from tree to tree. There is no known remedy for the chestnut blight.

Italian and American chestnut and Chinquapin are subject to it. Japanese and Chinese chestnut is largely resistant. We are hunting to find an immune strain of American chestnut but have not found anything that may be called hopeful as yet. We are planting nuts borne by blighted sprouts from blighted trees. How long it will take to develop immunity, if ever, remains to be seen.

Another most destructive fungous tree disease has been introduced from Europe prior to 1906. It is the white pine blister rust (Cronartium ribicola) which attacks all 5-needle pines, eastern white pine, Rocky Mountain or western white pine, limber pine and sugar pine of California. The sporss enter the needles of young twigs

and work down on the limbs and trunk until the tree is killed.

The fungus pushes out yellowish blisters through the bark which release spores. Luckily these spores can not spread to another pine but must develop on the leaves of currants or gooseberries, (Ribes genus) where they can spread widely from bush to bush. In the fall a different but delicate kind of spore is produced on the ribes which may again infect pines. This spore can not travel far or be exposed long.

This double cycle offers a point of attack. By removing all gooseberries and currants for 600 to 1,000 feet from 5-needle pine stands and nurseries, infection may be prevented. The white pines are doomed where the ribes species are not kept exterminated.

Any canker-like attack on the white pine bark, dead limbs, or dead tops of young pines should be brought in for examination by the forester. Any gooseberries with yellow patches on the under side of the leaves should also be brought in for inspection. Blister rust is more widely distributed than has been reported in all probability.

While the above two fungous forest tree diseases are the most destructive to large trees of any known in America, there are many other serious fungous diseases. Recently a disease, belonging to the genus Nectria, has

killed a third of the beech trees in Nova Scotia and is spreading south. It seems to follow the spread of the European beech scale, and has been found in Maine. It is hoped that the climate may decrease its attack further south, but it is very threatening.

The so-called "damping-off" disease in nurseries isdue to the work of minute fungi which attack the seedling at the ground surface on hot damp days. Nurseries with coniferous specieslike pitch pine must have their young seedlings sprayed with bordeaux or copper sulphate solution. These are special problems for nurserymen.

Another group of fungi that any forest owner and forest lovers should recognize is the group that causes heart rot of trees. They generally are recognized by the fruiting bodies or "conks" on the sides of trees, generally at some opening or wound. Trees showing such fungous fruiting bodies should be removed from the forest. One of the best ways of keeping the forest thrifty is to keep removing old trees and unsound and injured trees which harbor and permit these injurious fungi to propagate.

How do fungi grow? Since they have no "green chlorophyll" like higher plants, they must depend on animal or plant tissues built up from mineral elements by other

plants with green chlorophyll - which in the case of animals have been appropriated by them. The fungi have the power of producing enzymes or ferments which break down this plant or animal tissue and convert it into fungus "mycelium". One may see this mycelium in fuzzy mold webs, but generally the fibers are embedded in the material being attacked, as in the wood or bark of trees, or in the ground. When enough of this fibrous web like mycelium (like the roots of a higher plant somewhat) has been formed, the fungus pushes up its fruiting bodies, such as toad stools, mushrooms, puff balls, "conks" on trees, and a host of small and microscopic kinds like those of mildews, molds and rusts.

The farmer with wheat rust which is harbored by the barberry, and the orchard man with apple scale, which is harbored by the red cedar (Juniper) trees have fungus problems just as the forest owner has.

(d) Questions. Identification of miscellaneous forest specimens.

(e) Field Trip. Should include examination of blighted chestnut, white pine blister rust damage where available, a wood operation illustrating the use of cord or board foot measure. Estimate the logs in a few merchantable trees with their small end dimmeters, and add up the board foot

volume of the tree by the Doyle Rule. This volume may be compared with the following "Scribner" and "International Rule" values:-

(All values are for 16 ft. logs)

Dib. of log (inches)	Doyle Bd. Ft.	Scribner Bd. Ft.	International Bd. Ft.
6	4	18	20
8	16	32	45
10	36	54	70
12	64	79	105
14	100	114	150
16	144	159	200
18	196	213	255
20	256	280	320
22	324	334	390
24	400	404	470

Lesson 5. (a) Our Past and Present Forest Resources.

(1) Pennsylvania.

Pennsylvania is a name meaning "Penn's Woods" or forests. It was a most apt name at the time it was adopted. Then the state was clothed with thrifty forest which was rarely equalled in its density and variety of commercially valuable trees anywhere in the world. While exceeded in timber volume per acre by the Pacific and Northern Rocky Mountain forests, they contain coniferous species only, while ours included the finest of temperate zone hardwoods as well as the magnificent virgin white pine and hemlock. Large areas averaged 20 to 25 thousand board feet per acre. Our younger people can have little conception of these vast virgin forest resources that once clothed the state except from the very rare and small remnants preserved in a few state parks or monuments such as the Alan Seeger and Detwiler Run State Forest Monuments, the Snyder-Middleswarth State Park in the central part of the state; the Cook Forest Park, and the nationally owned Hearts Content in the northwestern part.

Simon B. Elliott (deceased) an early member of the State Forest Commission, told of running a railroad survey through virgin forest in northern Pennsylvania in the

IRREGULAR PAGINATION

early days on which a white pine 6 feet in diameter was cut down to give a clear line of sight.

In fact, estimates indicate that our state once contained over 300 billion board feet of standing timber (12 M. ft. per acre). This was made up of hemlock and white pine mixed with beech, birch maple and basswood in the northern part of the state; the same type with increasing mixture of oaks, chestnut and tulip poplar along the southern mountain axis; and magnificent forests of white and red oaks and hickory on southern lime clay soils, with chestnut, red oaks, chestnut oak and tulip poplar predominating on non-lime soils. Many other valuable minor species like cherry, walnut, elm, ash, cucumber and some others were scattered through favorable sites for these species1

A forester cannot help remarking what a proper forestry management could have done for this vast forest property if our forefathers had had foresight and advanced forestry training. It may be agreed that it was necessary and desirable to remove one half of this virgin forest for farms, towns, transportation avenues, etc. It may be concluded also that the heavy stocking of merchantable timber on the remaining half of the land properly should have been reduced fifty percent in order to put the forest into a

thrifty growing condition. Still there should have been left about 25 percent of the original stand in the form of the younger and thrifty trees on 50 percent of the total land area for future production. This would have given us a permanent forest stand of about 75 billion board feet from which to cut only the annual growth. Placing this at 3 percent, an annual cut of 2,200 million board feet would have been possible down through the centuries. It might be remarked that this would have kept our timber and wood industries going at their peak of the 1890-1900 decade. Instead of this vision of the forest as a permanent resource, hemlock and chestnut trees were cut down for their tan bark and the wood left to rot on the mountainsides before there was a market for it. Firest were allowed to run and burn up more trees than were taken out for lumber.

Fire was especially destructive to coniferous seed trees and young growth. Whereas in 1899 the state cut 2,333 million board feet of lumber, consisting of 78 percent conifers, in 1928 or 30 years later, it cut 238 million board feet which wasonly 36 percent coniferous. Thus the total lumber cut fell 90 percent in 30 years but the conifers cut fell 95 percent.

In 1924 Pennsylvania paid 22 million dollars freight on lumber from outside the state and 47 million for

the lumber itself or 69 million total. Pennsylvania imports at least 50 percent of its pulpwood, much of its tanning material, considerable mine timber, many of its R.R. ties, almost all of its poles, as well as barrel and keg staves and other lesser forest products. It is not wide of the mark to sum up the cost of forest products that we could raise on our own forest land at 100 million dollars a year in normal years. This sum goes beyond our borders each year because of past mis-management of our forests. It is a minimum measure of the gross income we can restore to the state through intensive forest restoration. Each 5 year period we go further and further for our forest supplies and the costs go up a step.

100 million dollars means $1000. income for each of 100,000 families lost to the state. But the loss does not stop there - furniture factories, pulp mills, tanneries, spoke plants, and other secondary forest industries have left the state because of a scarcity of wood. The big log-boom and the fine large sawmills and the large tanneries at Williamsport are gone. The mill, log boom and tannery at Lock Haven are gone. The towns of Cross Fork, Norwich, Sinnemahoning, Endeavor and a dozen others are gone, and others as Galeton, Lock Haven, Renovo, Jersey Shore, Emporium, Ridgway and a multitude of others have felt the

heavy hand of vanished forest industries.

The same story can be told in Michigan, Wisconsin and Minnesota and it is just now being completed in Florida, Alabama, Mississippi, Louisiana, Arkandas and Texas.

Not only have forests, forest industries and towns vanished. The cut over and burned lands are now becoming tax delinquent by the million acres in some states. In others they add a frightful erosion loss to this land management failure of private forest exploitation.

(2) The Nation. The nation's virgin forests at one time covered 822 million acres and were estimated to have contained 5,200 billion board feet of saw timber. This has been reduced to 495 million acres and 1668 billion board feet of saw timber - not one third of the original. The degree of our forest management failure is seen in the following statement:

	Acreage (mill-acres)	Saw Timber stand (bill.bd.ft.)
Total present forest	495	1668
Old growth still left	99	1346
Area cut over	396	322

In other words, while cutting over 396 million acres and cutting 1650 billion board feet of lumber alone, we have built up only 322 billion board feet of second growth to take the place of the old growth cut. Thus we have grown to saw size only one fifth of the amount of lumber cut. And what has been grown is far below the quality of that cut. Further this second growth is two thirds in the south and west while the market is in the north and east.

At the same rate we will have built up only about 400 billion board feet of second growth by the time our remaining 2 percent (in area) of old growth timber is cut.

Even allowing for reserves in cordwood size trees, we discover we are taking out 16 billion cu. ft. of wood each year (depression period shows a large reduction) on the average and growing but 9 billion cubic feet. In other words, we must increase our forest growth 80% or decrease our timber consumption 45% to balance our budget.

The establishment of the C.C.C. camps is the first large national acknowledgment of the size and scope of our reforestation problem, apart from the establishment of the National Forests to continue forest production on nationally owned mountain lands mostly in the far west. The great majority of our states still do not relize the scope or the economic import of the land use - reforestation

problem.

(c) Protection of Forests (concluded). (If an enlisted member has studied entomology, he might lead this period.)

In the last period we have discussed some of the fungous diseases of trees and found that the most dangerous ones were those that attacked the inner living bark - a vital point in the life of a tree. It is in this "cambium zone" where the plant food elaborated in the leaves is changed to wood cells. This zone is also the artery for circulation of plant fluids. If you kill the bark around the tree in even a narrow zone, the tree dies. This is the reasn why the chestnut bark blight, and the white pine bark blister rust are so destructive. Their ability to spread indefinitely (unopposed) is the second important factor. The inner bark of the tree is a vital spot. Therefore, insect pests that prey on this inner bark and have the power to multiply in large numbers are very dangerous and destructive - these are the pine bark beetles in the case of the pines, the western pine (bark) beetle (Dendroctonus ponderosae) and the southern pine (bark) beetle (Dendroctonus frontalis) have done great damage to western yellow and southern shortleaf pine forests.

The southern "turpentine borer" (Buprestia apricans) is a serious enemy to southern slash and longleaf pines when chipped for turpentine or burned at the base. It bores into the exposed heart wood and weakens the trunk so that the wind blows down millions of trees. These beetles do the damage as adults. The measure to control these insects is to keep brood trees and weakened (potential brood) trees cut out. Keep the forest growing vigorously. In some cases the broods of bark borers are killed by spraying the standing tree with crude oil and setting it on fire before the brood has emerged. This can only be done safely when the forest is wet and open.

Another example of the wood boring beetle is the locust borer (Cyllene robiniae) which may be found in all parts of Pennsylvania where the locust grows. The mature beetle feeds on golden-rod in September. They are about three fourths of an inch long and black with bright yellow and bands running across the back and thorax. Their larvae bore into the trees and often so weaken them that the wind breaks them off.

Another locust insect is the locust twig borer (Ecdytolopha insiticiana) whose larvae produce lumpy swellings with their gallery in twigs, sprouts and young seedlings. These seem to be less severe when the locust

grows dense or partly shaded.

Another important shoot borer is the white pine weevil (Pissodes strobi) which kills the leaders of white pine. These may be found in almost any plantation or natural stand of white pine saplings 2 to 10 feet high. The eggs of the weevil are laid in the leader when it is young. The larvae (white grubs) pulverize the wood of the leader. One remedy is to cut the infested leaders off in June as soon as they first wilt and burn them with the grubs inside. White pine should be planted in mixture not less than 6 x 6 feet. Partial shade reduces injury from the weevil.

There are numerous insects that destroy the tree buds, needles and leaves. One of the worst of these is the spruce bud worm (Harmologa fumiferana). The adult is a grayish brown moth. The damage is done by the dark brown caterpillar with yellowish-white warts, which is about 3/4 inch long. They may defoliate spruce and balsam and kill entire stands.

Various saw-fly larvae defoliate conifers - notably the larch saw-fly.

One of the most destructive forest tree leaf eaters (particularly the oaks) in the gypsy moth (Porthetria dispar), introduced into New England from Europe and now spread into eastern New York and Northeast Pennsylvania

which is being attacked by the federal government forces in an attempt to hold it in check in the Northeast. The last years eggs, in buff colored oval masses an inch or more in diameter, hatch in May and early June. The full grown caterpillars are 2 1/3 inches long, brown with tufts of hairs and have blue and reddish warts down the middle of the back. The female moths (late June to Sept.) have a wing spread of about 2 inches. They are white with wavy black marking, and are so heavy that they usually do no flying. Hence they spread slowly unless transported on nursery stock, cars or wood products. Power sprayers with arsenic spray and the cutting clean and burning of badly infested stands of trees are resorted to at considerable expense to control the pest until natural parasites can be introduced and multiply.

Another leaf eater that has reached destructive numbers in Northeastern Pennsylvania in the last few years is the Elm spanworm (Ennomos subsignarius), a measuring worm formerly attacking lindens, beech, maple and hickory, but now attacking the oaks extensively as well.

Trees weakened by defoliation by the elm spanworm or by drought, are often attacked by the 2-lined chestnut borer (Agrilus bilineatus), and small blackish beetle 3/8 inch long with a whitish line down the back. The

larvae riddle the inner bark and sapwood and have killed many oaks in the last few years. The only forest remedy is to cut out weakened and attacked trees.

Another common leaf eater is the common apple tent caterpillar (Malacosoma americana) which can be found wherever wild cherry is abundant. Its webs in the crotches of trees are conspicuous. Burning the webs while the caterpillars are young (in April or May) is the principal remedy. Arsenic spray also can be used. These caterpillars rarely kill forest trees.

The thick "White grubs", larvae of the June beetles, do much damage to the roots of seedlings in forest nurseries.

There are many other important larvae, caterpillars, leaf beetles and scale and gall insects, etc. that cannot be described here, but one needs attention. This is the introduced Japanese beetle (Popillia Japonica) which attacks lawns, many shrubs, fruit and fruit trees, ornamental trees and some forest trees. An extensive government quarantine is operated to slow up its spread until parasites can be developed. Arsenic sprays are good for this pest. The larvae eat the roots of grass but the tree damage is done by the beetles. Camp members from Philadelphia know this bronze black beetle a little larger

than the potato beetle, but shaped like it. They love the sun and are not expected to seriously injure the forests.

It should be noted that many of our worst insect pests like the gypsy moth, the Japanese beetle, the San Jose scale, and many agricultural insect pests like the cotton boll-worm, the European corn borer and others, are introduced from other countries. Very often native insects will multiply in destructive numbers for a few years, but then subside when checked by natural enemies and parasites. The introduced species may have no natural checks or parasites until such are identified and introduced and propagated in sufficient numbers to hold them in check. In the meantime the insects may do untold damage. The climate and the food supply of the new location may also be more favorable for the rapid increase of introduced insects as well as funguous diseases.

The forester must know which pests may be expected to be checked by natural enemies and which require special action. The general citizen is most interested in insect attacks on ornamental and fruit trees. He should generally seek the advice of foresters, horticulturists, or better still entomologists.

(b) Tree and Shrub Identification (continued)

Broadleaf simple alternate-leaved trees and shrubs; trees - Poplars, sycamore; shrubs - Wild plum, hawthorn, gooseberries, ninebark, sweet fern.

THE POPLARS (Populus Sp.)

The terms poplar, aspen and cottonwood are all applied to different members of this group of trees belonging to the genus Populus. They are light-demanding trees, rapid growers, and reproduce freely on open areas by both seed and root suckers. The leaves are alternate, broad, usually prominently toothed, and long-stalked. In some of the members, particularly the aspens, the leaf-stalks are flattened in a plane at right angles with the leaf blades, which permits the slightest breeze to set them in a trembling or quaking motion.

Their buds are usually large, scaly and more or less resinous. As a rule they possess brittle twigs and branches, easily broken off by storms, which detracts from their value as ornamental trees. The flowers appear before the leaves on large pendulous catkins. Trees of this group produce a wood that is extremely light and soft, valued principally for wood pulp. Only the three commercial

species native to Pennsylvania will be considered in this lesson. They may be separated as follows:

1. Leaves triangular (deltoid) in outline; terminal buds large, angled, resinous..... Cottonwood or Caroline Poplar (Populus deltoides)

1. Leaves ovate to nearly round; terminal buds about 1/4 inch long, rounded, devoid of resin or only slightly resinous 2

2. Leaves finely serrate; buds smooth, sharp-pointed and glossy ..... Trembling Aspen (P. tremuloides)

2. Leaves coarsely toothed; buds covered with fine whitish pubescence, blunt-pointed, and not glossy ..... Large toothed Aspen (P. grandidentata)

TREMBLING ASPEN (P. tremuloides)

A peculiarity of this tree, which attracts attention, and from which its common and scientific names were derived, is the leaf's habit of being nearly always in motion. The day is remarkably still if the foliage on trembling aspen is not stirring. This is due to the long, flat leaf stem, which is so limber that it offers little resistance to air currents. Then too, the difference in

color between the upper and lower sides of the leaves affords sufficient contrast to attract notice, and for that reason a person will observe the motion of aspen leaves when he might fail to see a similar movement among the leaves of other species where the contrast of colors is not so marked. Its leaves average about 2 inches long; are ovate or nearly round in shape, usually abruptly short pointed, bordered by finely toothed margins. However, on sprout growth and very small trees occur leaves with a heart-shaped base that are two or three times as large as those on older trees.

Trembling aspen is a usually rather small tree, with straight undivided trunk, narrow crown, and with thin foliage. Like paper birch, it is one of the first trees in northerly regions, to take possession of burned and lumbered areas, as well as old fields and clearings, or wherever bare mineral soil is exposed to open sunlight. Its very small seeds are produced in enormous numbers and winds carry them for miles. Also, the tree spreads rapidly by its root sprouts or suckers. It makes rapid growth, but is short-lived. However, this species often serves a useful purpose as a nurse plant to the young of other forest trees; that is, it affords light shade and shelter to tender

seedlings of other spceies which in time replace it. If crowded it speedily gives up the fight and dies.

It has a smooth bark that varies from ashy-gray to yellow, but quickly changes to a rich olive green when wet by rain. The twigs, too are smooth, shiny, and tan-brown, with sharp-pointed, conical, dark varnished buds. Like gray birch and paper birch, the trunk shows characteristic dark patches below the bases of the branches. On old trees, the bark becomes black just above the ground, thick, rough, and deeply furrowed.

Trembling aspen is credited with being the most widely distributed tree of North America. It is transcontinental and ranges from Newfoundland to Alaska, south to Pennsylvania, Iowa, New Mexico, and California. In Pennsylvania it most commonly occurs in the northern portion of the State and is a constant associate of the northern hardwood or "beech - birch-maple" type of forest. It produces a wood that is nearly white in color, soft, weak, and not durable when exposed to the weather. Next to spruce and hemlock, it is the most important pulpwood in this country, and it is coming into considerable use as lumber. The whiteness of the wood - it looks much like holly - makes it a favorite for small boxes and vessels for shipping and containing foods. It is also used in great

quantities for the manufacture of excelsior. The tree is locally called "popple".

LARGE-TOOTHED ASPEN (P. grandidentata)

A tree similar in character to trembling aspen but easily distinguished from it. Attains larger size usually than trembling aspen, with more yellowish-green bark (not so ashy-gray in color) and branches that are less ascending. The buds are stouter, not so sharp pointed, usually divergent, and covered with a flour-like, crusty coat of wool. Its twigs, too, are not so smooth and are more yellowish-brown, often finely pubescent or scaly. In summer the two aspens are readily separated by their leaves, for those of large-toothed aspen are quite coarsely toothed (trembling aspen leaves have a finely serrate margin) and average about twice as large as those of its near relative. It is the leaf-margin that is responsible for its near relative. It is the leaf-margin that is responsible for the common name "large-toothed", and for the scientific designation "grandidentata".

When its leaves start unfolding in early spring, large-toothed aspen is a rather conspicuous tree. The young leaves are covered with a whitish down, and, together with the woolly young shoots and dangling flower tassels, give it a silvery cloak that contrasts sharply with the new

green foliage of other tree species. For a brief period then this aspen can be recognized for long distances. On the other hand, the developing foliage of trembling aspen stands in sharp contrast, for, instead of being a dull silvery white, it has a marked glossy, "oily" appearance that is distinctive.

It is sometimes called aspen, popple, white poplar, and large poplar. Trees may reach a height of 70 feet with a diameter of 2 feet, but a height of 40 or 50 feet is more usual. The species ranges from Nova Scotia to Minnesota, southward to Delaware and Illinois, and along the Appalachian mountains to North Carolina and Tennessee. The wood is used for purposes similar to those of the trembling aspen. There is a drooping-foliaged form of this tree in common cultivation, known as P. grandidentata, variety penduliformis.

COTTONWOOD OR CAROLINA POPLAR (P. deltoides)

This tree is considered the largest of our native poplars. Its range covers all of the United States east of the Rocky Mountains. It is in the Mississippi Valley, however, that cottonwood occurs in greatest abundance and reaches its largest size. It prefers rich bottomlands

and frequents stream courses throughout its range. Black willow is one of its most common associates. This poplar ranks among a small number of tree species found on the western outposts of the prairie forests, where it clings to river banks and to islands in the rivers; occurring in such places, it is supposed to be one of the few original timber trees of the plains region and survived the Indian's fires, which he presumably kindled annually to improve the range of the buffalo.

Cottonwood has leaves that are triangular or wedge-shaped in outline, their form sometimes being termed "deltoid" (resembles Greek letter delta), hence the scientific name "deltoides". They are characterized by coarse, forward-pointing, curved teeth that resemble those of a circular saw. With their long, flattened leaf-stems and deep glossy green color, its leaves could scarcely be confused with those of any other native poplar. The buds are large, resinous, glossy, and chestnut brown in color, with the under sides of the bud scales sticky and odorous. They are borne on stout, tan-colored twigs that are round to angular in cross section, depending on their rate of growth.

The tree shows good form, with branches ascending in habit. Usually the bark is grayish brown in color and

strongly seamed, with conspicuously confluent ridges. In spring the pistillate (female) trees bear enormous quantities of down, resembling cotton (hence the common name cottonwood); attached are the minute seeds which are carried for long distances by the wind. Like all other members of the genus "Populus", thie species is a rapid grower and reproduced naturally by seeds, sprouts or root suckers, and artificially from cuttings.

Cottonwood has been used extensively for ornamental planting in the streets, parks and private grounds of many of our cities. But experience has shown that it makes a poor tree for street planting; objections to it are the habit of its roots to clog sewers and drain pipes and to lift pavements and its brittle branches which the wind breaks off easily, and the constant litter from twigs, leaves and flower tassels. For appropriate places it has the advantage of ease of propagation by means of cuttings which enable the nurseryman to offer the trees at a lower price, of rapidity of growth, producing shade a few years after planting, of comparative freedom from insect or fungus attack, and of smoothness of foliage which keeps clean even in the smoke-laden atmosphere of the manufacturing cities.

Cottonwood has been planted widely in the prairie regions

of the central West for shade, windbreaks, fuel, building and fencing material, and to prevent erosion; in that section it was probably the commonest tree upon which "tree claims" for land were formerly based.

It produces a white wood that is made into nearly every kind of box that goes on the market. Manufacturers of food products are particularly anxious to procure this wood. It is one of the best for woodenware, such as dough boards and ironing boards. It is used by manufacturers of agricultural implements, interior finish, bank and office fixtures, musical instruments, furniture, vehicle tops, trunks, excelsior and numerous others.

SYCAMORE (Platanus occidentalis)

Probably no person with a practical knowledge of trees ever mistakes sycamore for anything else. At all times the tree stands clear-cut and distinct; in every feature it shows individuality, with no chance for confusion with other trees. Attaining extremely large size, Michaux, the French botanist, called it "the most massive vegetable of eastern North America". Although some may excel it in height growth, in diameter of trunk it is exceeded by no other American hardwood. However, the mammoths are generally hollow, thus defeating all efforts to determine the great

age to which they must attain. Needing an abundance of water for its roots, sycamore thrives best on moist, fertile ground, particularly along the banks of rivers and creeks; often it crowds so close to the water's edge that the current has partly undermined its root system. Ranging from Maine to Minnesota, and south to Florida and Texas, it is the only representative of its family in eastern United States.

Mature trees can be recognized from a distance by their massive form and conspicuous spotted bark. Both the trunk and larger branches show a characteristic mottled appenrance in which large white blotches stand out most markedly. Closer approach reveals a beautiful blending of white, olive green, yellow and brown in sharply defined patches and streaks over its bark surface. Such peculiar bark pattern results from the flaking-off of the scaly brown outer bark, thus exposing its vari-colored inner layer.

Almost as strikingly distinctive are its leaves, fruit, twigs, and buds. The almost circular, palmately-lobed leaves have a size and general outline much like that of a grape leaf, and, were there more coarse teeth, the resemblance would be most marked. When the leaves unfold

in spring they are accompanied by prominent fan-shaped stipules, borne at the enlarged nodes, which may persist far into the winter. Another conspicuous leaf feature is the swollen base of the stalk, beneath which are hidden next year's odd cone-shaped buds; few other trees bear subpetiolar buds. Naturally, after the leaves have fallen, each winter bud shows a broad scar encircling its base. Unfortunately in late spring the foliage often suffers from a blight which kills back the tips of the twigs, thus tending to disfigure the tree when planted as an ornamental.

Another ready means of distinguishing sycamore is its fruit, occurring in the form of small balls suspended singly, or rarely two together, on long, tough, wiry stems. Each spherical ball varies from 3/4 to 1½ inches in diameter, and is an aggregate head composed of many club-shaped, closely-packed, hairy seeds or achenes. At first they are green, but turn light brown when ripe; with a surface roughened by the rounded exposed ends of the inclosed seeds. It is from these odd fruits that the tree derives such common names as buttonball and buttonwood. Persisting on the branches through the winter, each fruit cluster breaks up and the light seeds are scattered short distances by wind, but much farther by running water.

Sycamore produces wood that is hard, tough, and difficult to split, with medullary rays extremely prominent since they are not only wide but darker than the body of the wood. One of its earliest uses was by farmers who cut hollow trunks, sawed them in lengths of three or four feet, nailed bottoms in them and used them for grain barrels. They were called "gums". Solid logs two or three feet in diameter were cut in lengths of a foot or less, bored through the center, and used as wheels for ox carts. The ox yoke too was often made of sycamore. From the earliest times butchers have used sycamore sections about three feet high for meat blocks; the wood is tough and continual hacking fails to split it. Its modern uses are many, including furniture, boxes and crates, tubs, candy buckets, lard pails, washing machines, trunks, interior finish, and it still is a choice wood for barber poles and saddle trees.

The oriental plane is a common and fairly satisfactory shade tree often seen in parks and along highways. It resembles native sycamore closely but is more regular in habit, darker, and has smaller leaves.

WILD PLUM (Prunus americana)

A shrub or small tree, with curved angular branches, scragged, and covered with slender thornlike

twigs. Ranging from New Jersey to Montana and southward to Florida and Mexico, its territory covers about a million square miles. It varies in height from 20 to 35 feet, and from 5 to 10 inches in diameter, with a rounded compact crown, the trunk dividing not far above the ground. Usually it occurs in dense clumps from root suckers, in old fields and clearings or along fence rows and the banks of streams.

Early in spring, when the leaves are about one-third developed, the wild plum is covered with clusters of small white blossoms. In late summer appear the ripened fruits, about an inch in diameter, usually with a tough red skin and yellow flesh, containing a flattened oval stone. Its narrow, pointed leaves, sharply double toothed, assist in recognition of the tree.

People of rural districts sometimes gather these wild plums for preserves and jellies. When altogether ripe they have a quite agreeable though tart flavor. Before planted orchards were common, the early settlers relished this plum, which was regarded as one of the best wild fruits that nature offered. It is said that wild plum trees were abundant about the sites of Indian towns and old fields, where the savages had scattered seeds without any purpose on their part of planting trees.

Later the pioneer settlers probably imitated the Indians, for plums were soon growing in the vicinity of most of the cabins. Thus our wild red plum was among the earliest wild fruits to become domesticated. Many modern varieties belong to this species; it also furnishes an excellent stock upon which to graft the domestic plum. Being heavy, hard, strong, and dark rich brown, the wood is suitable for turnery and small novelties, though little of it has been used.

HAWTHORNS (Crataegus Sp.)

An extremely difficult and complex group of small, thorny trees and shrubs, consisting of hundreds of species and varieties scattered through many parts of the world. They afford a perpetual source of study, victory, and bewilderment to the trained botanist. No less an authority than the eminent dendrologist, George B. Sudworth, has said: "No other group of American trees presents such insurmountable difficulties in point of distinctive characters." Nevertheless, there are specialists working on the hawthorns who apparently delight in making new species, which in some instances none but themselves can identify. There are now described in the United States more than 700 species; in New York State

alone some 218 species have been found. Though some few species are easily identified, to be able to tell that a small tree is a hawthorn is all that the average person should attempt.

In general, the hawthorns are known locally by such common names as haw, red haw, scarlet thorn, thorn bush, thorn apple, or hedge thorn. Demanding open sunlight, they usually are found in abandoned fields and fence-rows, with a decided preference for limestone soils; with very dense, often flat-topped crowns, their zig-zag, interlacing branches are covered with slender thorns that are stiff and sharp. They force their way into vacant spaces, where the seed usually was carried by birds, and their thorns protected them against browsing animals.

Equally distinctive marks of identity are afforded by their blossoms and fruit, both of which resemble that of apple and pear trees, their close relatives. In May, the clusters of white blossoms, set against a background of green foliage, make each hawthorn bush a thing of beauty, attracting a great variety of bees and other insects by their strong and peculiar fragrance. Again, in autumn, covered with bright-colored berries (usually red or scarlet, but variable in many colors and sizes, depending on species), they are rather conspicuous, the branches frequently remaining laden with fruit after the leaves have fallen.

Though the berries are of little use for human consumption, some of them have a tart and not unpleasant taste.

Generally the hawthorns are too small for the wood to be of any commercial value. Some species, however, produce wood that is extremely hard and dense, occasionally utilized as a lathe wood for engraving blocks, small wedges, rulers, and napkin rings. Scarlet haw (C. coccinea) checker pieces have been compared with ebony for wearing quality. Perhaps their most extensive use is in the manufacture of canes, most species being suitable for that purpose on account of their weight, strength and hardness. In the case of Cockspur thorn (C. crus-galli), its formidable slender spines, from 3 to 8 inches long, strong, and extremely sharp, were formerly used as pins to close wool sacks in rural carding mills. As is well known, the European hawthorn (C. oxyacantha) is still a favorite shrub for hedges in England; occasionally our native species are so used in America, though not to any considerable extent.

CURRANTS AND GOOSEBERRIES (Ribes Sp.)

Every forester and woodsman should be familiar with our wild currants and gooseberries, for they serve as intermediate host for the white pine blister rust. This deadly disease that attacks all species of five-needle pines

is seriously threatening their extermination within the United States and Canada, just as the chestnut blight has all but eliminated our once valuable American chestnut. This blister rust, during its life cycle, migrates from currant and gooseberry bushes to white pines standing in the same neighborhood. Its spores are mostly carried by wind. Since the disease cannot travel directly from an infected to a healthy pine, unless first completing an alternating stage on species of Ribes, foresters and pathologists combat it by destroying all Ribes bushes in the vicinity of white pine areas. This requires a systematic campaign, costing the government millions of dollars, but is the only known way to effectively protect immense stands of valuable timber.

It is not difficult to recognize wild currants and gooseberries as a group, though identification of species may not be so easy. The genus Ribes includes some 60 or more species native to the north temperate zone. Only two of them are really common in Pennsylvania. They are low shrubs, usually less than 5 feet tall, often covered with sharp prickles. They occur in all sorts of locations, from swamps to dry, rocky ridge tops. The alternate leaves are palmately lobed or veined, frequently fascicled, with small, tubular, white to yellowish-green flowers occurring solitary;

several in a group, or in drooping racemes along the twigs. Usually the rounded berries are edible, turning purplish in late summer, though eagerly sought by birds as they ripen. Our two common Pennsylvania species may be identified as follows:-

Berries covered with prickles; spines few or absent on the twigs ..... Prickly Wild Gooseberry (R. Cynosbati)

Berries smooth; twigs quite prickly ..... Eastern Wild Gooseberry (R. retundifolium)

A considerable use was made by the early settlers of the fruit of the wild gooseberries for making jams and jellies. From these wild species, through proper culture and improvement, have originated our more productive domestic varieties, some of which bear fruit as large as small plums. In suitable localities, a promising opportunity yet exists for further breeding, selection and improvement. However, the blister rust now makes it necessary to destroy both wild and tame currant and gooseberry plants already growing and to prevent new plantings wherever white pine is an important forest tree and there is danger of that disease being spread to valuable forest areas.

NINEBARK (Physocarpus opulifolius)

Ninebark occurs generally on rocky banks of streams and edges of woods where it can obtain open sunlight. It is a much branched and spreading shrub, from 4 to 10 feet tall, with long, more or less recurved branches, and many slender wandlike shoots arising from the base of a common clump. Its range extends from Quebec to Georgia, thence westward to Manitoba and Kansas.

It is the bark that gives rise to its common name. In general appearance, the stems resemble miniature red birches, with their loose, somewhat tan or salmon-colored, shaggy bark that peels off in numerous layers and curls back in thin papery strips. Quite commonly this loose exfoliating bark extends well out along the branches. The shrub is characterized by smooth, slender, bright tan-colored twigs, with fine ridges extending down from each leaf base.

Its leaves, flowers and fruit aid materially in identifying ninebark. Usually somewhat 3-lobed and palmately veined, with crenate margins, the small rounded, dark green leaves, though borne alternately, are rather maple-like in appearance. In May or early June appear the rounded clusters of white blossoms that closely resemble some spiraeas; they are borne in many-flowered terminal corymbs 1 to 2 inches broad. This attractive floral display is transformed in early autumn to purplish, rather showy seed pods. Like little inflated bags (termed a follicle), each pod is smooth,

membraneous, about the size of buckshot, 3 to 5 celled, and many occur together in a cluster; finally turn pale brown and persist into the winter. Sometimes the bush bears such a heavy burden of fruit that its slender branches are bent almost to the ground.

Ninebark is commonly used for ornamental plantings; sometimes, though not often, for hedges. It can be easily propagated by cuttings.

SWEET FERN (Myrica asplenifolia)

The sweet fern which, of course, is not a fern but a fern-like shrub, grows 1 to 3 feet high, with commonly a dull red or dark brown, scragged, woody stem. Wherever found, its round-headed bushes generally occur abundantly, preferring such places as stony uplands, dry pastures and open woods, particularly where sterile sandy soils abound. Its long roots, creeping along just under the surface of the ground, send up suckers so freely that on occasional areas pure dense mats of sweet fern choke out all competitors. One of the true ferns, bracken fern, is possibly its most common associate. It occurs from Nova Scotia to Manitoba, south to North Carolina, Indiana and Michigan.

Sweet fern was so-named from its leaves. Being long, slender and finely cut (pinnatifid), they do resemble

somewhat the fronds of a fern. Also, they are dark green and shining above, much paler and smooth beneath, with the margin slightly rolled-under. It is, however, their strong, though pleasant, spicy fragrance, particularly when crushed, that gives to the plant its most well-known feature. If atmospheric conditions are right the whole neighborhood in their vicinity may be permeated with a sweet pungent odor, the memory of which the huckleberry picker brings back with him from the mountains. Those who have burned brush or fought forest fires in summer where sweet fern abounds are familiar with its strong fragrance given off by a volatile oil contained within the leaves. The rusty green, bur-like fruit, too, which appears in autumn, is very aromatic when crushed.

In winter, the sweet fern may be identified by its fine twigs covered with short brown hairs and minute buds. Also, staminate catkins are present, crowded at the tips of the twigs; they are about a half inch long, stiff, erect, cylindrical, and covered with pale brown hairs. The plant is most frequently found on dry sites, particularly where rock oak and pitch pine flourish or where forest fires have burned severely.

(d) Questions. Identification of miscellaneous specimens.

(e) Field Trip. This weeks field trip might well include (1) a visit to virgin or at least a good stand of merchantable timber if any exists in the region; (2) a visit to a plantation or timber stand showing material insect injury by one or more of the insects discussed, or one or more of the numerous forest insect pests of greater or less importance. The mound-building ants and their clearing of shrub and young tree growth around their hills by the injection of formic acid into the cambium on the lower part of the tree trunk are interesting. This tree injury can generally be found about ant hills in pine plantations especially. The District Forester may know of such.

Or, ants guarding colonies of aphids for feeding on their secretions make an interesting study, though of little economic importance to the forest. Many other insect studies will suggest themselves to the forester.

Lesson 6. (a) How Trees Grow. Measurement of their Growth and Volume Increment. (Have on hand several tree sections with clear rings.)

Trees grow in height by extending their stems and branches from terminal buds. They grow in diameter by adding an annual ring of wood immediately beneath the bark, as well as a layer to the bark on the inner side. The cells forming the wood and bark tissue are elaborated, largely from carbon taken from the air by the leaves and minerals taken through the roots in solution from the soil. The green chlorophyll in the leaves acts under the influence of sunlight as the master chemist in the process, and is incompletely understood by plant physiologists as yet. Since the leaves have this function, the more leaves (the larger the tree crown) the larger the amount of wood growth put on. Shade and ornamental trees with large crowns, grown in the open, therefore grow faster, at least in diameter. They put on wider rings of wood.

Diameter Growth. The spring wood and summer wood in the annual wood layer (ring) added, differ somewhat in structure and therefore in appearance. The spring wood is generally lighter in color and more porous. Some species of trees have annual rings very easily separated by the eye in counting. Others are more difficult. The very slow growing trees with very narrow rings sometimes require a hand lens to count them. The total age of the tree equals the total number

IRREGULAR PAGINATION

of rings plus the estimated years required to grow to the height where the section was cut. For ring counts on stumps 1 to 2 feet high one to four years would be added according to species - in exceptional cases like southern longleaf pine much burned over, even a greater period is added.

Narrow rings indicate shading by taller trees or crowding when a considerable number of trees adjoin. Single narrow rings or single wide rings indicate individual dry or wet years. In fact much past climatic fluctuation and change in the forest cover can be read in the tree growth rings. Lumbering or great storms that have reduced the forest density and increased the light and thus stimulated growth rings can often be specified to the exact year.

When stands of trees have been planted in the same year, or have come up from natural seeding after clear cutting lumber operations, or great storms, or forest fires, they are said to be <u>even-aged stands</u>. Stands of mixed age trees (small, medium, and large) are <u>uneven aged stands</u>.

Young trees are generally less crowded than older ones and often grow faster. Ten rings to the radial inch (5 to the diameter inch) is an average growth in forest stands in Pennsylvania. This may be increased by thinning and in rapid growing species; decreased by crowding and in slow growing species.

Height growth varies principally with "site" (quality of soil, and moisture conditions, altitude, etc.) Some few coniferous trees when young (white pine) put out one whorl of bramches each year. These trees may have their age told by counting the whorls. This will not work in other species, but the beginning of each year's growth can sometimes be noticed for 4 or 5 years from the seedling state by a thickened band. The way to get the height growth for large trees is to count the rings at each section. By subtracting the upper count from the next lower count the years to grow the length of the section is determined.

The forester wants a tall tree free of lower limbs, so as to produce as much lumber as possible free of knots. He, therefore, wants to keep the trees spaced closely so the lower limbs will be shaded out early and the small knots resulting will not extend much beyond the center cut of lumber. Growing trees in dense stands reduces the size of the crown and slows the diameter growth on the individual tree. The ideal timber tree grown under forest management, should have a crown occupying about one third the length of the tree.

Measuring the wood growth in single trees and stands.

We have seen how to get the age of a tree by counting the rings when it is cut down. The measured volume of the tree divided by the age gives the average wood growth put on

each year. So with an acre of standing trees, the trees can be counted and measured for diameter and height. Their volumes can then be secured from volume tables (explain) and added up. Several average sample trees can be cut and the average age secured. The total quantity of wood in cords or board feet divided by the average age will give the average amount of wood or lumber grown each year.

When it is not desired to cut down "sample trees", their age can be ascertained by use of the "increment borer", a hollow auger that extracts a core of wood upon which the rings can be counted from bark to center or as far as is desired.

Often the forester or forest owner wants to know at what rate percent his trees are growing. With the increment borer he finds that his average trees (say 12 inches in "diameter breast high") had 8 rings in the last radial inch, hence grew from 11 inches in diameter to 12 inches in 4 years. By comparing cross section areas there was an increase of 19% from 11 to 12 inch trees. This required 4 years, hence the tree is growing at $4\frac{3}{4}$ percent in volume. As a matter of fact it does a little better since this assumes no height growth.

There is a simple method to approximate this "growth percent" without a table for the area of circles. It is known as "Schneiders formula" and is 400 divided by the diameter times the rings in the last radial inch. It gives

a percent somewhat low for trees in their prime. Thus the above example would give 400 divided by 12 times 8 or 4.2 percent. This formula for merchantable diameters of trees will give better results if the "diameter" value is taken inside the bark. In this example, (allowing 1.4 inches for bark on both sides) it would be 400 divided by 10.6 times 8 or 4.72 percent.

Permanent Sample Plots. You may have seen in the forest a square plot of perhaps 1 acre (208 ft. each way) on which a white number was painted on each tree and a white dot below it. These are permanent sample plots laid out in forest research to secure the wood growth of the stand. These trees are measured (caliper for diameter) each 5 years and the dimensions recorded. The volume is then secured for each tree from volume tables and the total added. One fifth of the increase in volume from the last measurement gives the current annual wood growth. This is the most accurate method and the results from a large number of plots of different aged forest stands will be made up into a table to be used in estimating the wood growth and value produced per acre in managed forests. Such tables must be made for each species of timber tree in pure stand.

These wood growth figures are applied to an entire

forest area under management to find the total wood growth each year. This is used to limit the amount cut and keep the forest intact or increasing when below standard. This will be further discussed under "forest management".

(b) Tree and Shrub Identification. Broadleaf, simple alternate-leaved trees - elms, hackberry and sweet gum; shrubs - teaberry or wintergreen, spicebush, sassafras (shrubs conspicuous to taste of leaf, bark or root).

THE ELMS (Ulmus Sp.)

Two species of elm are native to Pennsylvania, namely the American elm and slippery elm. They are graceful and attractive trees, each with a wide distribution and quite valued commercially. Their leaves are simple, alternate, 2-ranked, doubly serrate, with short stems, unequal bases, and prominent veins. The flowers appear before the leaves in March or April. Shortly thereafter the ripened fruit clusters are present. Each fruit consists of a small flat seed, surrounded with a thin membraneous wing, and is known as a "samara". Our two native species may be differentiated as follows:

Leaves quite rough on both sides; twigs gray and rough; buds velvety; inner bark mucilaginous .....Slippery elm.

Leaves slightly rough above, pubescent but not rough below; buds smooth; inner bark not mucilaginous ..... American elm.

AMERICAN ELM (Ulmus americana).

The American elm is one of our best known and

most admired trees. For beauty, stateliness and grace, few trees surpass it. When open-grown, it attains imposing proportions, sometimes 120 feet tall and 3 to 10 feet in diameter, with gracefully arching branches. Commonly the trunk divides about one-third of the distance up into many stout, outwardly curved branches, forming a tree with a symmetrical round-topped crown. Its form has been variously likened to that of an umbrella, vase, or inverted cone. The prettiest of American elms have a form that resembles the spray of a fountain, the upward jet of water corresponding to the trunk of the tree, while the outward and downward curves of the spray represent the crown of the elm. Michaux, the French botanist, pronounced the American elm "the most magnificent vegetable of the temperate zone."

Probably most common on the flood plains of streams, the American elm also frequents wet woods and low-lying rich soil generally, in company with other hardwoods. Its range stretches from Newfoundland across Canada to the eastern base of the Rocky Mountains, thence south to Florida and Texas, covering in the aggregate about 2,500,000 square miles; a few other trees have ranges as large but none much exceed it. It covers so much of America and is so important in many parts of its range that, of the six species of elm occurring in the United States, our American elm is undoubtedly entitled to first place.

Originally the largest specimens were cut in the Ohio and Mississippi valleys. Now the finest elms of this country, and doubtless the finest in the world, are the planted trees in some of the New England villages, many of which are more than 200 years old, though the north central states rival them strongly.

In winter the American elm may be recognized by its smooth, slender, reddish brown twigs, nearly always drooping. Near the tips of the twigs occur the leaf buds; they are ovate-acute, slightly flattened, usually smooth, and red brown with dark-margined scales; the flower buds, much larger and blunt-pointed, are located along the sides of the twigs. Though small, the semi-circular leaf scars, each containing three sunken vascular bundles, are helpful means of distinction; they much resemble those of black gum, In general, the bark is grayish-brown in color, divided by many short, perpendicular furrows into flat-topped ridges, exceedingly rough and firm, though at times scaly. A cross section of the bark ridges often shows alternating layers of white soft cork and brown material that are not present in other species of elm.

In spring and summer its leaves, flowers and fruit, and of course the form of the tree, all assist in identifying this elm. The alternate leaves, usually 3 to 5 inches long,

are two-ranked on the twigs, doubly serrate, with unequal, lopsided bases; they are prominently feather veined, with the veins sunken on the upper surface and projecting on the lower side. Usually the leaves are smooth or slightly rough on their upper surface, sparsely covered with soft silky hairs beneath; those of slippery elm invariably seem harshly rough on both sides. A noticeable feature of the American elm is its rather thin foliage, concentrated largely near the ends of the limbs. But, even before the leaves appear, one may identify the tree in early spring by the dense clusters of tiny ball-shaped, slender-stalked flowers that line the twigs. Before the leaves have reached full size these flowers have transformed, each into an oval samara, about one-half inch long, consisting of a flat seed surrounded by a papery wing ciliated (fringed with hairs) on the margin.

American elm has always been regarded as one of the best species for shade tree planting. It is hardy, easily transplanted, makes fairly rapid growth, and for beauty of form it is not excelled. However, such insect and fungus pests as the elm-leaf beetle and recently discovered Dutch elm disease must of course be properly controlled. It produces a wood that is hard, tough, generally difficult to split, and rates very little below

white oak in strength. The name white elm distinguishes its wood from the redder wood of slippery elm, but also refers to the gray color of the bark. Although the wood has a wide range of uses, probably the greatest amount finds its way into slack cooperage (barrel hoops, staves and heading), agricultural implements, wheel hubs, and furniture.

SLIPPERY ELM (Ulmus fulva)

Slippery elm is a commonly irregular and characteristically rough tree, rough in bark, leaf, and most other features. Lacking the beauty and symmetry so conspicuous in American elm, instead of slim and drooping, its branches are stout and ascending, and leave the trunk more or less at random. The tree is partial to calcareous soils, often found growing on limestone outcrops or on the edges of limestone sinks; the type of location consistently avoided by such species as chestnut and pitch pine. Although often associating with American elm because of its preference for rich alluvial soil, the slippery elm is able to tolerate much drier sites. Most commonly it occurs singly or in groups, seldom in pure stands, scattered among such other trees as sugar maple, beech, white ash, basswood, tulip, white oak, and sometimes black walnut or butternut. Though ranging from the lower St. Lawrence river through Canada to North

Dakota and south to Florida and Texas, it rarely is common in any locality within that vast area.

Undoubtedly the tree is best known by its bark. On older trees it is a dark gray brown, quite rough, scaly, and deeply furrowed. The outer bark is soft and corky, with reddish brown under layers, but lacking the white streaks between the bark layers as in American elm. The innermost layer next the wood is white, aromatic, and slippery when chewed (mucilaginous). It is this inner bark which gives the tree its name slippery elm. It has always been used by those baseball pitchers who rely for success upon their uncanny "spit-ball" curves. Agreeable to the taste of both man and beast, though of questionable food value, this inner bark has long been used for medicinal purposes. In many localities it is hard to find a slippery elm from which some of the bark has not been peeled at some time or other. Formerly the bark was a household remedy which most country families kept in store along with various herbs depended upon to rout diseases in the days when few physicians were available. This inner bark was gathered, dried and put away for use. When needed it was pounded to a pulp, moistened with water, and applied as a poultice, if an external remedy was wanted. If a medicine was needed, a decoction was drunk as tea. There is no question that

the remedy often produced good results when no doctor was within reach. A well-known medical writer said three-quarters of a century ago that the slippery elm tree was "worth its weight in gold". Modern medicine might not support this estimate.

In winter slippery elm may be known by its: medium stout, grayish, rather rough twigs covered with a tough bark. They too have a mucilaginous inner bark. They bear ovate, dark chestnut-brown, velvety buds, at times enlarged by gall insects. With the approach of spring, even before the leaves unfold, the close observer will notice its numerous, though inconspicuous reddish blossoms, clustered on short stalks along the sides of the twigs. Soon after the flowers have emerged the characteristic fruits develop. These are flat samaras, round or oval in shape, with the wall over the seed coated with fine hairs, but having the wing of the fruit smooth and not hairy along its margins, as is that of the preceding species. In summer the leaves of slippery elm are an absolute means of identification. Though in shape resembling those of American elm, its leaves are larger and very rough on both sides; so rough are they to the touch that when crumpled in the hand the "crunching" sensation is quite unpleasant.

The average mature size of slippery elm is

scarcely half that of its near relative, American elm. Few trees exceed a height of seventy feet and a diameter of two. Its wood, though rated stronger, more durable, and with a redder heartwood than American elm, serves almost exactly the same uses. Those who call it red elm have in mind the color of the heartwood, or they refer to the tawny pubescence on the young shoots and buds in winter; the scientific name "fulva", meaning red-brown, also describes that characteristic of the tree.

HACKBERRY (Celtis occidentalis)

This is a tree with a very wide range, within which it exhibits much variation. Occurring over the major portion of the United States east of the Rocky Mountains, and also, though sparingly, penetrating the northwestern states as far as Puget Sound, hackberry deserves credit as being one of our few transcontinental trees. In some remote corners of its immense range of about 2 million square miles it is little more than a shrub. Sometimes within one small area, probably due to differences in soil moisture, individual specimens may be erratic and show striking contrast in size and manner of growth. To see it at its best one must visit the lower Mississippi Valley region, where it attains a size and dignity comparable to that of

the American elm, reaching a height of 100 feet and with a trunk diameter of three or four feet. Being practically confined to the fertile soils of drainage basins, and generally found growing close to streams, it shows a strong preference for limestone regions. Nowhere does it occur very abundantly, practically never in pure stands, and more often as single trees far apart. Frequently the people in a neighborhood do not know what a hackberry tree is and suppose it to be the last representative on earth of some disappearing species.

Hackberry is a cousin of the elms, to which, in some of its features it bears a superficial resemblance. Mature trees, when found growing on deep alluvial soils, usually have a wide-spreading, round-topped crown that is dense with fine, often drooping twigs. The bark, however, is quite characteristic, being commonly studded with corky projections suggestive of warts, which may extend as much as an inch above the general bark surface. Sometimes these protuberances run together, causing thereby what looks like an ordinary longitudinally-ridged bark, or they may be entirely absent, leaving a smooth gray bark scarcely distinguishable from that of beech.

But there are other features too that assist in identifying hackberry, for it is a tree that shows individuality. Take one of the slender twigs, cut it lengthwise

with a sharp knife, and notice the fine chambered white pith that it contains. Another peculiarity of this tree is the frequent presence of "witches brooms", which are abnormal dense growths of small twigs and branches, caused by two parasites, a mite and a fungus, living together at the expense of the tree. Then too, the buds, though normally small and pressed flat to the twigs, are often swollen and malformed, as are also the adjacent twigs, due to stings of gall insects. With the above features of form, bark, twigs and buds in mind, the student of trees should have little trouble to recognize hackberry during the winter months.

In spring, when the leaves are just developing, appear the small greenish flowers; three kinds, staminate, pistillate, and perfect may occur on the same tree or even the same branch. They result in a long-stemmed, cherry-like fruit, known as a drupe, borne solitary or few together in the axils of the leaves and near the ends of the twigs. Not until September or October, however, do they finally ripen into a purple-black (berry), about 1/3 inch thru, with a tough, thick skin and containing a bony, wrinkled seed. They are sweet and edible, but have so little pulp around the stone that they are hardly worth bothering with. Some birds are fond of them, though, and scatter the seeds far and wide.

Throughout the summer hackberry may be known by its leaves. They are few-veined but with three conspicuous ribs diverging from the base, and totally unlike the feather-veinad leaves of the elms. Though their unsymmetrical base is suggestive of an elm leaf, the resemblance ends there, for hackberry leaves are untoothed around the base, singly-toothed along the upper margin, and taper gradually to an acute tip.

It produces a wood that is heavy but only moderately hard and strong. Although somewhat like elm, it more resembles ash, for which it is generally sold. Its good bending qualities, causing it to be much sought for barrel hoops, gave rise to the local name "hoop ash". Probably the greatest quantity of hackberry goes into slack cooperage, baskets, boxes and crates, furniture and interior finish, hoe handles, and agricultural implements. In the middle West it is considered one of their most important shade trees, being readily grown from seed, easily trans-planted, able to withstand drought, and is a rapid grower. But since it is a rare tree and seldom reaches large size in Pennsylvania, hackberry is regarded here as of little commercial importance.

SWEET GUM (Liquidambar Styraciflua)

Although essentially a southern tree, sweet gum

is hardy as far north as southern New England. Pennsylvania claims it as a native tree only in a few of the southeastern counties of the State. Most common in the coastal plain regions, its natural distribution extends from Connecticut to Illinois, southward to Florida and Texas, and even reaches down through Mexico into Central America. Its preference for moisture causes it to inhabit chiefly lowlands, sometimes swamps, but it can exist on all sorts of soils except the poorest and driest. Trees of largest size and best development are found in the lower Mississippi Valley in rich bottom land which is subject to repeated inundation. However, sweet gum has been widely planted as an ornamental beyond the limits of its natural range.

Just as some men have striking physical features or traits of character that make of them outstanding personalities wherever they go, so also do many of our trees possess conspicuous marks of identity. Sweet gum is one of them. Its acquaintance may be easily established at any season, and when once known could not be confused with any other tree. Few of our hardwoods are more beautiful. Straight and tall, with the trunk tapering but slightly and usually continuing undivided through the symmetrical, rather connical crown, and with slender branches horizontal below but ascending at a 45 degree angle above, the form of

an open-grown sweet gum is distinctive.

Older trees have a grayish bark that is deeply and perpendicularly furrowed into broad, flat, scaly ridges. On the reddish brown, smooth, shiny twigs there usually develop the second season corky ridges that run lengthwise of the branchlets, or in some cases only corky excrescences. These rough projections occur on the upper sides of horizontal branches and on all sides of those growing in a vertical position, but on some trees they may be only sparingly developed or even absent. Bur oak is our only other tree species native to Pennsylvania that has this characteristic to such a pronounced extent. By cutting thru one of the twigs with a sharp knife there is revealed a wide, star-shaped, light brown pith. Also, the twigs bear pointed, shiny buds that if crushed emit an incense-like fragrance.

The curious fruit clusters may be found either on or under sweet gum trees throughout the year. Their size, shape, and appearance bear somewhat of a resemblance to the sycamore ball or the beech bur. Each is a prickly ball, about an inch in diameter, suspended on a thread-like stem, and composed of many spiny capsules. They seldom or never fall to pieces.

In summer the tree is readily told by its almost star-shaped leaves, resembling a lopsided star, having one of

the six points missing. From 3 to 6 inches long, but somewhat broader, each leaf has usually 5 (rarely 7) prominent lobes that are nearly straight-sided, with fine teeth on the margin. In addition to their distinctive shape, these leaves are deep glossy green and borne on long, slender stems. Like the buds, they are fragrant when crushed. It is in autumn, however, that the foliage of sweet gum is most conspicuous, with its contrasting colors of deep yellow, rich red, and dark maroon.

The name sweet gum refers to the pleasant odor of the gum or resin that exudes from wounds in the inner bark. Known under the trade name of "Coplam balm", and "styrax" this gum is of some commercial importance, and is shipped from New Orleans and Mexican ports. It is used in the manufacture of chewing gum, to flavor chewing tobacco, for treating catarrh and frost-bite, and is sometimes used in France and probably elsewhere to perfume gloves. A similar product from oriental trees, known as "storax" is used to burn as incense and has been known in commerce for many hundreds of years. Near the northern limit of sweet gums range trees yield little resin, but it is produced abundantly farther south. Centuries ago this gum was known as "liquid amber," for which reason the great botanist Linnaeus gave the name Liquidamba r to the genus containing this species and

related trees.

Few hardwood trees make more attractive and interesting ornamental specimens than sweet gum. Wherever it may be grown successfully it is exceedingly desirable for decorative plantings. It grows rapidly, and has few insect or fungus enemies, but is unable to withstand shade.

As a forest tree it has added much wealth to the southern hardwood lumber industry. The wood is heavy, hard, close but straight grained, and inclined to shrink and warp in seasoning. So heavy is the wood that in southern swamps large trees in earlier days were girdled and left standing for a year in order to dry out the sap and partly season them so the logs could be floated to the mills. Mature trees have a rich brown heartwood that can be finished to imitate circassian walnut, cherry, or mahogany. It is generally sold in furniture as "satin walnut". Other uses besides furniture include cabinet making, interior finish, boxes, slack cooperage, woodenware, and many more too numerous to mention. As a veneer material, it is demanded in four times the quantity of any other species. Also, the curious fruits (sweet gum balls) and corky winged twigs are sometimes used for decorations and fancy articles. Other popular names for sweet gum are red gum, liquidamber, gum, gum tree, alligator wood, bilsted, star-leaved gum, and, as mentioned above, satin walnut. Students of paleobotany claim this tree to be a survivor of every ancient geologic times.

TEABERRY OR WINTERGREEN (Gaultheria procumbens)

Probably few persons ever think of this tiny plant as being a shrub. Judging by size and general appearance, it looks more like an herb. Close inspection, however, reveals its creeping, underground stem, from which arise erect branches or shoots 3 to 5 inches tall. Crowded near the top of each shoot appear 3 to 7 dark, glossy, evergreen leaves, that are oval in shape, of leathery texture, and with margins obscurely toothed. All parts of the plant have a spicy, aromatic, or wintergreen flavor that is well-known to most country children of mountainous sections, where teaberry usually grows. Preferring cool, damp woods, especially in sandy soils, it nevertheless may be found on rather dry slopes and ridges, and quite commonly thrives beneath pine and hemlock, along with such other plants as blueberries, huckleberries, spotted wintergreen, partridge berry, and trailing arbutus. Both it and its common associates belong to the heath family (Ericaceae), all members of which like to grow on acid soils. Teaberry may be found from Newfoundland to Manitoba, and southward to Georgia, Tennessee, and Minnesota.

About July or August appear the dainty white flowers, drooping singly from the axils of the leaves, and half hidden under the foliage. The average person simply

admires their delicate waxy appearance as he strolls through the woods. But not the botanist, however. He must stop, examine them, and note that each flower is perfect, 5-parted, and urn-shaped. So also will the close observer know that, excepting for a few months in late summer and early autumn, itsbright red, fleshy berries may be gathered the year round. Though maturing late in October and November, they persist until May and June of the following year, increasing slightly in size. To discover a bed of teaberry is always a pleasant incident, particularly when the tender, spicy young plants, with a reddish tinge, are present.

Our teaberry or wintergreen is also known under various other common names, of which checkerberry is most often mentioned. Occasionally it may be called partridge or grouse berry, in recognition of its food value to these birds, particularly in winter, although this name properly belongs to another, still daintier, creeping vine. Following the notorious Boston Tea Party of Revolutionary War days, many homes used this plant as somewhat of a substitute for real tea, whence the common name teaberry or occasionally "mountain tea".

Today, in some mountainous localities, large quantities of teaberry leaves are gathered annually and made into wintergreen oil. This is an agreeable, aromatic product, possessing mild medicinal properties, and used also

in perfumery and for flavoring confections. Ten pounds may be distilled from a ton of leaves, Much of the so-called wintergreen extract of the market is, however, obtained from the bark and twigs of black birch. That made from black bir· on account of its lower cost,is generally used instead of the true oil of wintergreen.

SPICE BUSH (Benzoin aestivale).

The spice bush begins and ends its growing season in yellow. Its clusters of bright yellow blossoms, appearing in early spring before the leaves, fairly cover the branches. Finally, late October transforms it into a golden glow from the yellow of its changing leaves.

Like teaberry and sassafras, this bush is aromatic in bark, fruit and leaf. The pleasant odor of its crushed leaves and berries, since it resembles somewhat that of gum-benzoin, was what gave rise to its botanical name. The real gum benzoin of commerce, however, is obtained from Styrax Benzoin, a native tree of Java and Sumatra, wholly unrelated to this genus.

Spice bush is a stout branching shrub, 4 to 10 feet tall, with slender twigs and graceful form. Usually it grows in the shade of moist woods and along streams. It is said to occur only where the permanent ground water level lie·

within six feet of the soil surface.

Its smooth, green, brittle twigs, with typical aromatic taste, are pleasant to nibble while strolling through the woods. After the first year the twigs lose their conspicuous green color becoming, lower down on the stem, a dark brown and roughened with raised corky lenticels. In winter, when covered with numerous, superposed, round, green flower buds, in size and shape almost like B-B shot, spice bush is easily recognized. The leaf buds are smaller and flatter, sharp pointed, and occur solitary rather than in clusters.

When once known, spice bush is just as easy to identify in summer as at any other season. Then its pale green foliage is most characteristic. Though variable in size and shape, the leaves average 2 to 5 inches in length, are smooth with entire margins, and usually obovate in outline. Not until October or November do the ripened fruits appear. They are scarlet berries, with thin flesh, and each containing one large seed.

This bush occurs from Maine to Central Michigan and eastern Kansas, thence south to Georgia and Mississippi. Though of little economic importance at present, except for ornamental plantings, in the past spice bush has been variously employed throughout its wide range. A tea made from its twigs

and bark formerly served as a tonic and stimulant, especially in intermittant fevers. When blockaded by the Yankees during the Civil War many southerners were glad to use spice bush leaves in place of tea. Also, it is said that during Revolutionary times its powdered fruit made a fair substitute for allspice. This latter use gave it the name of "allspice bush", which has since been contracted to spice bush.

SASSAFRAS (Sassafras variifolium)

This is another of our aromatic woody plants that has familiarizeditself to all who claim even a slight knowledge of dendrology. Though usually a small forest tree, and often reduced to a shrub at the northern limits of its range, sassafras is mentioned by nearly all the travelers of 1600-1620 who visited our shores. The reason is that the bark, especially of its roots, was then believed to be a powerful medicine, capable even of renewing the youth of the human race. So highly was it valued during early colonial times that in the very first cargoes shipped to England from her American colonies was contained sassafras roots.

Even to the present day some portion of the above-mentioned superstition has clung to sassafras. Early medical practice, based largely on herbs and woody plants, valued it highly and its virtues and properties were described in almost

every "doctor book" that was written. At present, though not so highly esteemed for its medicinal value, sassafras tea, reputed to thin the blood and act as a spring tonic, is popular and the roots or bark are gathered and often sold commercially in most regions where the tree is known. But its supposed value was not confined to the roots and bark alone. In some of the southern states bedsteads were made of sassafras wood, with the belief that somehow they encouraged sounder sleep, particularly by driving away those well-known nightly visitors that disturb slumber. Floors were made of sassafras to keep out rats and mice. Perches of chicken houses were made of sassafras poles to keep off the lice. And to successfully make soap, it was necessary to stir the contents of the kettle with a sassafras stick. Other equally humurous incidents might be cited but these serve to illustrate the peculiar history attached to this tree.

Throughout its range from Massachusetts to Iowa and south to Florida and Texas, sassafras exhibits much variation of size and other botanical features as well. Most authors, however, have considered the many variations as one species. Although adapting itself to almost all sites excepting wet situations, in many regions the presence of this tree is regarded as an indicator of poorer soils. Frequehtly it invades waste and cut-over lands, fence rows, and forms

thickets in fields not recently cultivated. In some locations due to its unusual ability to sprout and root sucker profusely, sassafras becomes a pernicious weed species, extremely difficult to eradicate. Its best development is in Arkansas and Missouri, where trees 100 feet in height and 3 or 4 feet in diameter are not unusual. Some of its range it has occupied for vast periods of time, for sassafras leaves have been found embedded in the Cretaceous formations of Long Island and elsewhere. Formerly it was supposed that the tree existed only in the eastern half of the United States, but some time ago a species closely resembling ours, if not identical with it, was found in China.

No person should have difficulty in identifying sassafras at any season of the year. But of all its prominent characteristics, the leaves are most unique and easily recognized. Like mulberry, three different leaf forms exist on the same tree and often side by side on the same branch. The leaf form most frequently seen is oval in outline and with uninterrupted margins. Distinct variation is seen in the "mitten" leaf, which has a thumb-shaped projection to left or right, suggesting the fingerless glove. Other leaves are prominently three-lobed, and sometimes, though rarely, a five-lobed leaf is discovered. The leaves are alterhate, with smooth margins, and each type of leaf has three prominent

veins radiating from its base. They, as well as all other parts of the tree, may be unquestionably known by their aromatic smell and spicy taste. In autumn the leaves turn a bright reddish-yellow that is quite noticeable.

In early spring appear the greenish-yellow flowers along with the developing leaves. They are borne in tassels on the ends of the twigs. Late in summer they mature into erect clusters of dark blue berries, each carried on a bright red stem of fleshy formation resembling a club. These fruits do not persist into winter, but usually are eaten by birds which scatter the seeds, thereby insuring perpetuation of the species.

On young trees the bark is invariably smooth and green. Later it becomes reddish-brown, rough, and deeply cut into flat-topped ridges. For older trees, the best bark characteristic to remember is that when cut with a knife it shows a striking red-salmon coloration. Almost equally helpful is the form of the tree, with ascending limbs that are irregular and contorted, thus making it rather picturesque. The young twigs are quite brittle, with a greenish bark that if chewed is mucilaginous. Often they are covered with a bluish white, waxy coating and always contain a large white pith. The buds too are typically green and may be rather large if flowers are enclosed.

Woodsmen commonly recognize two varieties of

this tree, which they call red and white sassafras respectively. The roots of the so-called white sassafras are said to be much whiter than those of the other and by some regarded as poisonous. Also, the wood of this white variety is supposed to be less durable and to have an odor suggesting that of camphor. Although these claims may be heard wherever sassafras occurs, thus far no scientific work has been published to verify a division of the species. If any such differences actually exist they are probably due to age, habitat, soil, or some other such factor.

Sassafras produces a wood that is light, soft, coarse grained, and with a dark brown heartwood that is quite durable. In grain and color, it bears considerable resemblance to and is often sold as ash or chestnut, but is lighter in weight than either and much lower in strength. It is used for fence posts and rails, and sometimes for furniture and interior finish. More recently, sassafras wood, with the bark left on, has become popular for rustic furniture and for table lamp pedestals. The fact that it is so soft and easily worked, in addition to being durable, recommends it for such uses. About the only industry dependent entirely on this tree is the distillation of sassafras oil, derived from a volatile oil contained within the roots, twigs, and bark. This oil is much used for flavoring medicine and in

perfumery.

In suitable situations, sassafras probably deserves more consideration as an ornamental tree than it has previously received. The autumnal coloring of its foliage is beautiful. Other features recommending it for such use are its freedom from injurious insect pests, the food value of its berries for attracting song birds, and also its picturesque form and rapid growth. One serious objection, however, particularly for a street or shade tree, is its tendency to root sucker so profusely.

(c) Forest Products. In a previous period we considered the social services rendered by our forests, in affecting climate and rainfall to a degree; modifying water run-off in floods and low water; providing pure water for personal use in cities and country; controlling erosion of steep lands and the silting up of rivers, drainage or irrigation ditches, power reservoirs, and low agricultural lands; in contributing largely to hunting, fishing, recreation and health. Protective forests may also be planted to stop drifting sands, and in high mountains control snow slides and avalanches. These social services justify government forests apart from wood crops produced.

But important as those services are, the actual tangible, saleable products that the forest produces must determine whether private forest ownership can survive, outside of "luxury" hunting and fishing "preserves".

Pennsylvania

The first group of forest products are those used largely by farmers and include firewood and fencing (now largely posts for wire fences, formerly posts and rails).

In 1929, the last census year, Pennsylvania farmers cut from their farm woodlands:

		Estimated* average value
133	million board feet of logs	$15.00 per M.
859	thousand cords of fire wood	4.00 per cord
36	thousand cords of pulp wood	6.00 per cord
3,530	thousand posts	.20 each
622	thousand R.R. ties	.75 each
289	thousand poles and piling	3.00 each

all valued at $7,679,000. These products were used on the farm or sold for a substantial addition to the farm income. The value placed on the products is a low farm sale value. If the purchase value with transportation costs to the farms had been used for firewood, posts and lumber, the value could have been increased 50 percent, so that a large saving caused by home supplies can be claimed in addition to the cash value given. But even at this conservative figure there is a value of $2.29 in stumpage and labor returns from each acre of farm woodland. If these products are reduced to an approximate common solid wood volume, they represent an average cut of 34 cu. ft. of wood per acre on the 3,363,000 acres of Penna. farm woods. This may be taken as about the tree growth. It may be noted that this class of forest lands have about a balanced cut and growth. But by increasing the stocking of young trees on farm lands already partly in woods, and reforesting upwards

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* Estimated by the writer

of 2 million other idle acres that farmers could handle along with their agricultural crops, the farm wood crops in Pennsylvania could be much more than doubled. And what is more a home market in Pennsylvania exists for these wood crops. Also note when markets are low for wood products they can be left in the tree increasing in quantity, while agricultural and orchard crops must be sold each year, however low the price offered.

For the entire U.S. the farmers in 1929 cut exactly the same volume of wood products per acre (34 cu. ft.) as the Pennsylvania farmers cut. They averaged only $1.90 per acre farm price for the trees cut or 39 cents per acre less than the Pennsylvania farmers, indicating a better price in Pennsylvania for farm tree-products.

In Pennsylvania there is three times as much forest land outside of farm woodlands as there is in them. The quantity of logs cut on this larger area of non-farm forest is just about the same as that on the much smaller area of farm woods. The total pre-depression lumber cut of the state is put at 300 million board feet, with still further shrinkage in sight as the last large mills are cutting out. Against this small cut we are using about 1900 million feet of lumber annually. This is in contrast with the 2300 million board feet cut in 1899.

It is interesting to note that our farm land area began to fall at almost the same time our forest industry decline set in.

Except for lumber cut and farm wood products there are no recent data on the wood products cut in Pennsylvania. We know that in normal years our railroads, mines, pole using companies, paper companies, match factories, foundry pattern shops, furniture factories, and a host of other wood using industries are unable to secure sufficient supplies of wood materials for their use in Pennsylvania, but must go outside the state for large quantities of wood. The paper industry goes to Canada for some pulp wood and wood pulp, and even to Sweden for pulp.

United States

Based on the wood cut from our forestsin the entire United States as an average from 1926 to 1929 we may make the following brief summary. (Note that products from saw size trees still take by far the most wood).

	Equivalent tree volume cut*
Lumber - 38 bill. board feet	7.3 bill. cu. ft.
Fuelwood - 61 mill. cords	4.0 " " "
Hewed ties - 53 mill.	.6 " " "
Fence posts - 396 mill.	.6 " " "
Pulpwood - 5 mill. cords	.6 " " "
Mine timbers - 184 mill. cu. ft. (round) ..	.2 " " "
Veneer logs - 920 mill. bd. ft.	.2 " " "
Staves, heading, shingles, poles, piling, distillation wood, etc.	1.0 " " "
Total wood cut	14.5 " " "
Destroyed by fire	.9 " " "
" " insects and disease.....	1.0 " " "
Total wood taken annually from the forest	16.4 " " "

This cut is equal to 52 cu. ft. from each second-growth acre of forest with commercial restocking.

The present growth on these areas is not over 28 cu. ft. per acre leaving a large over-draft on the standing forest. This results in (a) further reduction of the virgin timber in the Pacific and Rocky Mountain regions; (b) in cutting young timber in the east that should be left to grow to more profitable sizes.

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* From the "Copeland Report" - U.S. Forest Service, 1933.

While the virgin timber in the far west should be further reduced to make room for a larger percentage of young growth, it appears that there will not be enough of it to last at the increased rate of cutting which must come as the southern pine supply decreases in the next ten years.

Elimination of forest fires, more carefully selecting and cutting ripe trees and leaving seed trees in merchantable stands, and reforesting millions of acreas of abandoned farm and barren forest lands by planting or natural seeding, are measures the nation, states and communities must take to increase our wood crops on our forest land. Forest thinning and cutting of defective and undesirable trees are further measures to step up our forest crop production. Road building is one of the primary steps in forest fire protection, as well as furthering the harvesting of timber and fire wood and opening the forest domain to the immediate enjoyment of the people.

We need more land growing forest crops and less land growing farm crops.

(d) Questions.

(e) Field Trip. To some wood using plant if possible. If possible, a sawmill should be visited, even if only a portable or custom mill. Explain the development of lumber sawing from the old hand "whip sawing" and "pit sawing" (one man above and one below the log); to the "up and down" water driven saw with hand carriage feed; then the water, steam or electric driven circular saws; and finally the power band saws which cut less kerf and are now being adapted to semi-portable mills.

Measure up a few pieces of timber or lumber, to show the board foot contents. Get the mill-run price and have the mill man explain how much of this is stumpage (cost of growing the tree), how much logging and how much mill cost.

If a planing mill is visited find the source of shipment of the lumber used, ask the freight cost, and estimate the stumpage, logging and milling costs. Show how much of the final cost if "labor" - woods, mill, or transportation.

If a saw-mill or planing mill was previously visited, a farm might be visited, and an estimate of the wood used in house, barn, sheds, fences, poles for telephone or current, machinery, and the different kinds and qualities of wood used pointed out.

Lesson 7. (a) Our National Forests.

Many far sighted citizens watched the lumber industry sweep from the North East through the Lake States into the South, leaving barren lands, deserted industry, abandoned towns and bankrupt local governments strewn in its wake. The last of our publicly owned virgin timber lay in the Rocky Mountains and Pacific Coast states. Much of this was passing into private hands for early exploitation, which began even before the South is cut out. In 1891 a public movement had secured enough backing to secure a law permitting the setting aside as "Forest Reserves" public lands (federal) carrying timber, and withholding these lands from private acquisition.

These government owned "Forest Reserves" were increased gradually until Theodore Roosevelt became President. He took a personal interest in the movement and after Gifford Pinchot became forester, transferred the "Forest Reserves" to the Dept. of Agriculture from the Dept. of the Interior in 1905. Roosevelt and Pinchot quickly changed the name of these forest lands from "Forest Reserves" to "National Forests", and included in them practically all the remaining publicly owned timber land and more than quadrupled their area.

IRREGULAR PAGINATION

At first there was much western public opposition to the national forests through a misunderstanding of forestry principles and methods. The detailed administration was at once removed to district offices close to the forests, reducing lost motion, red tape and friction in their handling. They were opened to the public. Free range and firewood were given local homesteaders. One fourth of their income was given to the local governments in lieu of taxes. Rangers and many higher officers were selected from the local population. Frazing privileges have been fairly handled.

Timber stumpage is sold where local needs require it, but the bulk is held off the market already demoralized by top heavy private holdings. In no cases are regional cutting budgets allowed to exceed the forest growth. This is the essence of forestry practice.

The national forests include 161 million acres (not at all timbered) and contain (with indian reservations and state forests) over half of the standing timber west of the plains. Most of this has cost the government little or nothing. The forest capital, range value and game resources are being increased. At the same time the great watersheds, reservoirs, dams of irrigation projects, power developments and city water supplies are being protected. But the lands are also opened to millions of tourists and those in search

of recreation. In time the national forests will pay a large net income. They are already setting the example for the wise handling of large private forest properties.

The benefits of the western national forests were so evident that the eastern states demanded national forests within their borders also. Since these eastern states contained no nationally owned lands, and most of their timber lands were cut-over, to establish national forests required the purchase of this cut-over forest land. In 1911 the first appropriation was made for this purpose. Up to June 30, 1932, there has been purchased or negotiated 4,727,680 acres costing over 21 million dollars, or at an average cost of $4.48 per acre. This includes lands in the Lake States, New England States, Appalachian States, Southern States and Puerto Rico.

The U.S. Forest Service estimates that there should be purchased over 7,600,000 acres additional to complete these units at a cost of almost 31 million dollars. The President has recently made available 20 million dollars toward this program as a part of the Emergency Conservation Plan. Emergency Conservation Camps are being located on some of these lands for developing roads, trails, telephone lines and initial forest protection work.

Much of these eastern purchased national forests,

like the earlier western National Forests are located in mountain regions of rough topography where water control is paramount, and recreational use most attractive to the city and plains populations. Many of the nation's rivers have their headwaters in the National Forests.

Use of National Forests.

The national forests are being developed on the principle not only of perpetuating present timber, range, and game resources, but of actually increasing these capital resources, so that the annual timber, grazing and game product may be gradually stepped up in quantity utilized. This will also increase the forests water protective function, decrease erosion, and improve recreational values.

Timber

The present early stage of development naturally finds the timber removed far below the annual growth, since national forest timber now merchantable lies mainly west of the plains, where privately owned timber is already being thrown on the market too rapidly for orderly forest management. The cut on the national forest in 1930 amounted to about 1,653 million board feet. This was probably not over 5% of the total cut of the country. When need develops

the national forests may furnish from 25 to 30 percent of our national requirement and will furnish the major income for this potential self supporting resource. Present timber sales require the removal of diseased or crippled trees and trees of inferior species. They also have slash disposal requirements aimed at reducing the fire hazard, and methods of cutting are directed toward increasing the seeding in of the most valuable species for the new crop.

There are several million acres of national forest (chiefly old burns) that must be replanted for a satisfactory growing stock. The federal nurseries are being expanded in the hope that funds will be available to step up the planting which is now pretty well out of the experimental stage.

Grazing

At present one of the resources permitting practically full utilization in the National Forests is the forage value on open portions for cattle and sheep grazing. In 1931 there were grazed seasonably under permit on the National Forests one and one third million cattle and six and a half million sheep, with small numbers of horses, goats and swine. This was the smallest number in 6 years due to the 1930 and 31 droughts. Grazing control like

timber cutting control is important in building up over-grazed ranges, and in erosion control. Regulated grazing also contributes to reduction of the greater fire hazard on grass areas. At present, although grazing rates are below those on private lands, grazing brings in an income from the national forests which ranks it with timber sales. As fuller timber utilization is approached grazing will fall in relative importance to timber.

Irrigation

An irrigation map of the western United States shows how the irrigated areas most often lie adjacent to the national forests and receive much of their life giving water from them. The irrigationists appreciation of this national forest service is one of the larger factors in the growing public demand for the increase of the national forests even in the west. It is seen that Government ownership in many cases is the only guarantee of the necessary reforestation of cut over privately owned forest lands.

Recreation

From 1917 to 1931 the recreationists visiting national forests increased from 3 million to over 32

million. This is one of the most rapidly increasing uses that these lands provide, though it does not show at all in the cash income statement. Rather they increase the expense side through camp site maintenance, road and trail construction, and increased administration and protection expense. But the public agrees that this is money well spent.

Some half a million hunters take 100,000 big game animals annually from the national forests. Hunting and fishing contribute considerably to state incomes through state license fees collected for this national forest use. There are 289 state and 24 federal game refuges on the national forests. These forests are estimated to contain over one million big game animals - deer, bear, antelope, elk, moose, mountain sheep and goars.

Forest Protection

Forest protection has continually improved, so that in the face of a greater number of fires due to more people using the forestd, the acreage burned over has steadily gone down.

Forest Plans

Timber cutting, grazing, and other uses are carefully handled under plans covering a period of years, as are permanent improvements, all leading to increased capacity of

service for the forest lands.

The annual income for the national forests amounted to 6.7 million dollars in 1930 and the administration and protection amounted to 11.6 million dollars (with an additional 6.2 million put into capital improvements). The current water, recreation and other free public benefits, with the increasing value of the capital assets, make this excess development period expenditure desirable as a step to larger continual social service and a future net income of considerable size, when timber is most needed.

The national forests are a conspicuous example of successful government administration of a vital basic land resource.

(b) Tree and Shrub Identification (continued)

Broadleaf simple alternate leaved trees and shrubs; tulip, cucumber, chestnut; shrubs-witch hazel, red bud, leatherwood, winterberry.

TULIP TREE (Liriodendron tulipifera)

Often termed "the gentleman of the forest", few hardwood trees surpass tulip for its clean, handsome, well-kept appearance at all seasons. Notable for its great size attainable, tall smooth columnar trunk, beautiful foliage and tulip-like flowers, practically every feature of the tree is outstanding. Though generally known by botanists as tulip tree, lumbermen prefer to call it yellow or tulip poplar, and sometimes locally as white wood. It belongs to a very old group of hardwoods which have come down from remote geological ages. Two species, one in the United States and another in China, are the only survivors of this genus now found in the world.

The tulip tree is native from Rhode Island to Michigan and Missouri and south to Florida and Arkansas. Its best commercial range has never been that extensive, but has clung pretty closely to the Southern Appalachians, with some enormous large trees occurring originally in Ohio, Indiana and Illinois. Tulip prefers moist, rich, well-drained soils, with

plenty of humus but no standing water. Since it formerly occupied the very best agricultural areas, much of the finest timber was destroyed when such land was cleared for crops. Now the largest trees are found in protected coves and on benches and lower slopes of mountains. Seldom do pure stands occur, but rather as solitary trees or groups of them scattered through forests of such species as white ash, beech, basswood, sugar maple, red oak, white oak and others that choose the best sites.

Like pin oak and ginkgo, tulip trees normally show a strong monopodial tendency. Growing remarkably straight and tall, with comparatively small crowns, forest-grown tulips early shed their lower branches and thereafter the trunks lay on nothing but clear wood. Their form is ideal for sawlogs; few American trees produce a higher percentage of clear, first class lumber. In diameter of trunk, tulip is, next to sycamore, regarded as the largest hardwood tree of the United States, and if both height and diameter are considered, its biggest known giants even surpass sycamore in size. As commonly seen, however, mature tulips reach a height of 80 to 120 feet and a diameter of 2 to 4 feet, though specimens 16 feet D.B.H. and 190 feet tall have been recorded

In addition to its characteristic form, tulip may be readily identified in winter by bark, twigs, buds and the

persistent cone-like fruits. Young trees have a smooth ash-gray bark that later becomes deeply furrowed, with short, rounded, confluent ridges. At a distance it resembles the bark of white ash, but is lighter colored and lacks the characteristic diamond-shaped fissures of the latter. Like basswood, hickory, and numerous other trees for which the sapsucker shows a preference, tulip bark seldom fails to exhibit many horizontal rows of evenly-spaced drill holes made by this species of woodpecker. The sapsucker, even though he does occasionally get "tipsy" on tulip's watery sap, must indeed have a cast iron stomach to enjoy its pungent-peppery taste. Despite the fact that all members of the Magnolia family, to which our tree belongs, have a bitter bark, tulip is so easily differentiated from its near relatives that this bark feature often proves helpful as a final check in identifying large trees, which may puzzle the student. As a home remedy, the inner bark, especially of the roots, has tonic, stimulant and diaphoretic properties.

The twigs too when chewed show a peppery taste. They are reddish brown, smooth and glossy, and contain a rather large white pith that is often divided by partitions of stone cells. It is the unique buds, however, that attract attention, particularly those on the ends of the twigs. The terminal buds are smooth, flattened and blunt-pointed, and appear to be

covered with a single cap-like scale; in reality, though, there are two spoon-shaped scales, united along the flattened margins of the bud. Though smaller and usually not so flattened, the lateral buds too frequently show this "duck bill" resemblance. In addition, the twigs have an odd telescoped appearance, caused by encircling stipular rings at each bud.

In summer the peculiar, somewhat shield-shaped leaf is a sure means of identification. In general outline broadly ovate, with truncate and notched apex, these leaves bear not even a remote resemblance to those of any other tree. They are carried on long slender petioles. The fact that the foliage, like that of the true poplars, flutters in the breeze, suggests a reason why the term "poplar", though a misnomer, is commonly applied to this tree.

And now we come to the feature, namely the flowers, from which tulip derives both its common and scientific name. In May or June they appear, half hidden among the leaves. It is their greenish-yellow color, tinged with orange-red, that blends so well with that of the foliage. Each flower in its outline is very suggestive of that of the garden tulip, being held erect on the end of the twig in a most characteristic fashion. The specific term tulipifera means "tulip bearing". They are 3 to 4 inches across, each with 6 petals and numerous long, pale green anthers. To be sure, they are freely

visited by insects, particularly bees. Their fertilization results later in a pointed, erect, cone-like fruit which, being composed of dry carpels, differs radically from the fleshy fruits borne by other members of the Magnolia family. These dry cones, composed of many single-winged parts arranged around a central stem, may conspicuously decorate the trees till spring. Gradually they fall to pieces, thus liberating the seeds, and leaving the central axes standing upright on the ends of the twigs. Tulip bears a high percentage of infertile seeds.

This tree makes very rapid growth, but is intolerant of shade and, because of the fleshy roots that are easily damaged, unusual care must be exercised in transplanting it. Despite the fact that numbrous successful tulip plantations have been established in eastern United States, considering its splendid qualification, altogether too little consideration has been given the tree in articial reforestation enterprises. As a shade and ornamental species it is deservedly a favorite. Several horticultural varieties have been developed.

Wood using industries have put yellow poplar wood into a multitude of products, and for some purposes they find it almost indispensible. Being light and soft, this wood seasons and works well. Because the logs are light in weight they float readily and lumbermen have usually pushed far up the

rivers in the Appalachian region, ahead of other cutting operations, to procure the finest timber available. It is the characteristic light yellow color of its heartwood that has given rise to the name of yellow poplar. Since it will impart neither taste nor stain, it has been an important wood for boxes and crates in which food products are shipped. Other important uses include woodenware, particularly ironing boards, bread boards, and pantry and kitchen utensils, as well as general construction, interior finish, and especially pulpwood. Many of the finest carriage and automobile tops are largely of this wood. Yellow poplar now enters into the best kinds of furniture, and is finished in imitation of costly woods, notably mahogany, birch, and cherry.

CUCUMBER _ (Magnolia acuminata)

Closely related to the tulip tree is cucumber, another member of the magnolia family which contains, from a geological viewpoint, some of the oldest of our broadleaf trees. Though possessing tropical characteristics in the form of large leaves and flowers, cucumber is our hardiest native magnolia, occurring naturally farther north than any of the other six species found in the United States. Its range extends from Western New York through southern Ontario

to Illinois, and south along the Appalachian Mountains to Alabama, Mississippi, and southwestern Arkansas. It occurs on low rocky slopes, the banks of mountain streams, and on rich bottom lands. Trees of largest size and in most abundance are found in the narrow valleys in eastern Tennessee and the western parts of the Carolinas.

In form, cucumber is a rather conical tree, quite similar to tulip. Its gray fissured bark, too, somewhat resembles that of tulip, though noticeably more loose and scaly, and usually with more shallow furrows. It is a curious fact that this ridged, scaly bark of cucumber looks quite different from the smooth trunks of other members of the genus "Magnolia." One of the best means of distinguishing the tree in winter is by its prominent silvery-gray and silky-pubescent buds. Those on the ends of the twigs are often nearly an inch long, are conical in shape and sharp-pointed, with but one scale fitting over them closely like a hood. They are borne on reddish-brown twigs that have a smooth, bitter bark, are quite round in cross section and, like tulip, contain a white semi-chambered pith.

In summer the tree may be easily recognized by its large oval leaves, from 6 to 12 inches long, 4 to 6 inches wide, and with an entire margin. Like those of basswood, the first severe frost in autumn turns them a blotched yellow-brown color, and maybe within a single day they will

all lie in heaps on the ground. All magnolias have rather large heavy leaves, though their size varies greatly with the species. In the matter of flowers, however, cucumber again differs radically from its brethren. Whereas most true magnolias bear showy white flowers in spring, either before or with the developing leaves, cucumber waits till late in May and then cleverly camouflages its pale greenish-yellow blossoms in a mass of mature foliage. In size and shape they differ but little from those of tulip. But they are so inconspicuous and emit so little odor that bees are not attracted sufficiently to fertilize them properly. As a result, often nearly half the seeds that ought to cover the surface of its odd cylindrical fruits fail to materialize.

When green, each fruit has an appearance very suggestive of a short, slightly-curved, warty cucumber, hence the tree's common name. As they ripen they change to a dark red color, at which time the bright orange-red seeds begin to push out of their receptacles and later hang suspended from 1 to 3 inches below the parent fruit cluster, each on a slender thread. There she seeds swing and dangle in the wind, often till mid-winter or later, before dropping to the ground. They are as bitter as quinine and no wild creature of the forest will touch them. Man, however, in his search for home remedies, macerated these seeds in

whiskey to make a medicine known as "bitters", claimed by some in former times to be a specific for all ailments. Today, though the fruits hang untouched, other features of the tree have been found to serve useful purpose.

The wood of cucumber is valuable and finds ready sale. Light yellow in color and of a satiny texture, it is soft, light in weight, close grained, and very much like that of tulip. In fact, it is claimed that the greater part of this lumber produced in the South passes as tulip at sawmill and factory. It is worked into interior finish for houses, flooring for cars, interior parts of furniture, woodenware, boxes and crates, and slack cooperage, including veneer barrels.

As a shade and ornamental tree cucumber has been planted im the northern States and Europe. For such use the chief value lies in its large, green leaves and symmetrical crown. Late in summer the red fruits add to its attractiveness and their peculiar nature lends curiosity and charm. Possibly the only objectionable feature is the tree's tendency to drop leaves more or less throughout the summer. It has practically no insect pests or fungus enemies.

CHESTNUT (Castanea dentata)

Here is a tree so common and generally well known that it scarcely needs description. But its habits will be

discussed nevertheless for the benefit of those who have never lived or visited in rural communities. Since the advent of the deadly chestnut blight which has all but exterminated this once valuable tree, to describe now its characteristics and unquestionably fine qualities resembles reading a eulogy over a dying soldier's body. For like the invasion of a hostile army, this disease due to a fungus, moved relentlessly through the hardwood forests of eastern United States, singling out every chestnut tree and leaving a path of destruction in its wake. Working beneath the bark, the fungus finally girdled each tree of our vast original stand, it generally taking from one to two years for a tree to die after being attacked. The spores of the fungus are carried from tree to tree on the feet of birds, on the bodies of insects, and by the wind. Even to this day no effective control measures have been discovered. As grim reminders of this notorious catastrophe stand those gaunt white chestnut skeletons outlined against the forest background of its surviving associates.

But our chestnut has not yet entirely given up the fight against its fungus enemy. Although its companion species are attempting to replace it by crowding into the openings that it was forced to vacate, chestnut too is struggling to maintain inself in the forest structure. Possessing remarkable sprouting ability, it has persistently

met its death loss with repeated crops of new sprouts that arise from the base of those killed by the blight. Of recent years many of these sprouts are reaching fair size and, where favorably situated, are bearing burs with viable nuts. Such observations, added to other recent evidence of progress, give rise to a hope that the chestnut has entered a new era in its long fight to evade extermination and that in time it will develop an immunity to the blight.

To recognize chestnut is not difficult at any season of the year. It is best known and most appreciated, however, when autumn frosts have opened its prickly burs, exposing the luscious brown nuts contained within their velvety pockets. Long before the nuts have dropped or even the burs have started to open, country boys, too eager to wait and anxious to get ahead of the squirrels, climb and club the trees and crack the nuts out of the burs. Sore fingers and bruised legs are considered part of the sport, and borne cheerfully by the proud possessor of a bulging salt sack that holds his treasure. Of course later, when the nuts have fallen to the ground, the ripe harvest must be shared with many wild creatures of the forest. Any person so unfortunate as to have never gathered chestnuts in the crisp atmosphere of an autumn woods has missed some of the most delightful experiences that out-door life in the country has

to offer.

Unlike most other forest trees, chestnut blooms in midsummer. In latter June or early July its white, erect, pencil-like plumes, set against the green background of its mature foliage, make of this tree a conspicuous object. These spike-like clusters of fuzzy blossoms are the staminate or male catkins. Usually they occur in abundance, but despite that fact the nut crop sometimes fails, due usually to a spell of rainy weather while the trees are in bloom. Too much rain hinders proper pollenization. On short stalks in the axils of the leaves occur the small rounded clusters of pistillate flowers that when pollenized develop rapidly into young burs. The latter, until they reach some size, are hidden among the long, taper-pointed leaves that differ so markedly from those of other trees. Usually several times longer than broad, each chestnut leaf is prominently feather-veined, while along its margins occur spiny, forward-pointing teeth.

Though in spring, summer and autumn chestnut may be known at a glance by its prominent leaf, flower and fruit characteristics, there are also a number of good ways of telling it in winter. Then it is that the deeply fissured bark, with broad flat ridges, stands out most prominently on older trees. Young trees may be known by their smooth trunks and branches, with twigs bearing small egg-shaped buds

and containing a star-shaped pith when seen in cross-section. When found growing in open fields or along fence-rows, chestnut develops a short trunk bearing aloft a very broad, wide-spreading crown. Usually one has but to look on the ground beneath a chestnut tree to recognize it by the presence of old burs that remain there for years before disintegrating. It is well to remember too, that this is one of our few trees that consistently avoid limestone soils.

Chestnut grows to immense size and is very long-lived. Before the appearance of the blight it was regarded as one of the most important timber trees of eastern United States. Ranging from Maine to Michigan and south along the mountains to Alabama, Mississippi and Arkansas, probably no hardwood species offered more promise of financial return from our impoverished mountain lands. Its exceptional sprouting capacity, which chestnut retained to an advanced age, assured a satisfactory regeneration following even the most ruthless methods of timber exploitation. It could grow on rocky slopes and ridges and was able to prosper where other valuable trees could barely exist. Few hardwood species made more rapid growth. Then too, in addition to its fast rate of growth, the fact that for post and rail material chestnut could be marketed in small sizes, meant that early thinnings were a profitable undertaking where this tree occurred in any abundance, as it frequently did. In forests

of the extensive oak-chestnut type it averaged probably 30 to 40 per cent or more of the tree volume or stumpage. Such stands at maturity could be closely utilized because chestnut furnished a variety of wood products. Thus, wherever present in any amount, chestnut was a key species, making possible successful forestry management either on short or long rotations.

As might be expected, the loss of a tree so important as the chestnut gave rise to a multitude of perplexing economic, silvicultural, and biological problems. Of immediate importance to land owners was the necessity to salvage, at a profit if possible, all this standing dead timber. In most cases it meant a tremendous monetary loss. For certain uses, such as fence posts, poles, ties, mine timbers, slack cooperage and tannin, for which chestnut wood, because of its exceptional durability and other good qualities, was highly valued, other satisfactory substitutes had to be found. Since the nuts of this tree provided a staple food for squirrels, wild turkeys, ruffed grouse, deer, and many other birds and animals, when deprived thereof these wild creatures were compelled to readjust many of their former habits of living, or often to migrate to more favorable localities. The presence of so much dead material in the woods represents a constant fire hazard and increased many-fold the problems

and cost of forest protection. It might be mentioned too that the death of the chestnut rendered worthless much early growth appraisal work, thus making it necessary to investigate anew all phases of the growth and yield that will characterize our reconstructed forests of the future. These few examples serve to show that a tree such as chestnut, growing abundantly over an extensive area and possessing so many admirable qualities, cannot pass out of existence without seriously complicating matters and forcing an intricate readjustment in the scheme of things.

WITCH HAZEL (Hamamelis virginiana)

Curiously enough, after all other woody plants have completed their flowering season and developed their fruits, then along in late autumn comes this unique spreading shrub with its delicate floral display. Some frosty morning in October or November you may be quite surprised to come across a large bush, 6 to 12 feet high, covered with touseled clusters of pale yellow flowers. They are not easily noticed, however, being somewhat camouflaged among autumn's brilliant colors, and particularly so since this shrub's own yellow foliage may yet be clinging to its branches. Their unseasonable appearance, together with the fact that they occur on the same twigs along with the seed capsules of the previous year, serve to attach to witch hazel

a rather uncanny reputation. While black alder is generally conceded to be our first woody plant to bloom in spring, when the witch hazel finally pushes out its curled and twisted streamers Nature says "positively the last".

It requires one full year for these flowers to ripen into fuuit. The tiny last year's seed capsules slowly mature as this year's flowers bloom. All winter long they persist in great abundance on the bare branches. Nut-like in appearance, each of these woody fruits is oval in shape, about a half inch long, and with a felt-like covering. Within are contained two cells that hold the seeds. Cold frosty weather causes their thick cell walls to contract and expand and to finally rupture with force sufficient to propel the smooth, glossy black seeds for some distance. On a sunny autumn day one may hear them snapping like toy pistols in the witch hazel thickets. Or the woody pods may be brought indoors where close observation affords much amusement.

Just why this plant has been called witch hazel no one knows, but several explanations might be advanced to account for it. Formerly its long forking brown branches were said to have been used as "divining rods" in searching for hidden springs of water or deposits of ore. By carrying such a forked stick in an upright position, the fork was supposed to bend downward when held over under-ground water

or mineral deposits. William Hamilton Gibson, in his "American Forest Trees", says: "The origin of the name witch hazel is disputed; but the person who examines the (gaping) open-topped button (fruit pod) which holds the black seeds, and notes the fantastic resemblance to a weasen face, will feel satisfied that he can guess the origin of the name". From the earliest days much superstition has centered about this unique shrub.

Ranging from Nova Scotia to Florida and west to eastern Minnesota and Texas, witch hazel may be found in the shade of either moist or dry woods. Often it forms thickets over considerable areas. Though generally of shrub size, with numerous stalks arising from a common base, occasionally it attains the proportions of a small tree. The largest specimens occur in the southern Appalachian Mountains, where a maximum height of 40 feet and a diameter of 18 inches have been recorded; but few people have ever seen a witch hazel that large.

The bark is smooth and light brown in color, marked with elongated lenticels, and with a reddish-purple inner bark. Being frequently mottled with light gray blotches, this shrub is said to have been called "spotted stick" among the Onondaga Indians of New York State. Its astringent

properties have caused it to be used in medicine. A fluid extract, distilled from the bark of twigs and roots, and containing about 15 percent ethyl alcohol, is familiar as the mildly soothing lotion sold as "witch hazel". Though producing a hard, heavy wood that is light brown and streaked with red, it seldom attains dimensions that would warrant utilization.

In winter, witch hazel may be known by its brown scurfy twigs that contain a light green pith. Their slender, flattened terminal buds are prominent marks of distinction. Like the twigs, they are covered with a scurfy pubescence and each is commonly bent towards the tip in a characteristic fashion. Close examination reveals no bud scales, the short brown hairs serving instead as protection for the undeveloped leaves. Probably the best distinguishing feature when the leaves are off is the abundance of seed pods that cover the branches.

During the entire summer witch hazel is clothed with large, alternate leaves of a shape that is easily recognizable. Being oval or rounded in outline, with an oblique base, each leaf has prominent straight veins and a wavy-toothed margin. They have short stems and, like the twigs and buds, are covered with a rusty pubescence. But, aside from these characteristics, there is another leaf

feature that is quite typical of witch hazel. Frequently its upper leaf surfaces are literally studded with prominent cone-shaped galls about a half inch in length. These reddish-tipped galls result from the sting of a small midge that always passes one stage of its life history on this particular shrub. So common and conspicuous are these galls on witch hazel as to furnish a reliable mark of identification.

REDBUD (Cercis canadensis)

This is a charming little tree, best known perhaps as an ornamental. Though more of a southern species, redbud is hardy when planted in northern United States and even Canada. Occurring from New Jersey to Missouri and south to Florida and Texas, it reaches its best development in southern Arkansas, Oklahoma and eastern Texas. In many parts of its range it is a small shrubby tree, often leaning or crooked, with branches irregular and forming a broad, unbalanced figure that has been likened to that of a miniature apple tree. Like witch hazel, it thrives in the shade of the forest, but is also commonly seen along fence rows, in abandoned fields, and on cut-over or burned-over areas. Usually it grows on rich loamy soils, and shows a decided preference for those of limestone origin. Not infrequently it occurs in thickets that cover entire hillsides, or in open forests forms a large part of the under-

story growth.

In early spring, about the time that Juneberry and flowering dogwood are in bloom, redbud too, with its mass of reddish-pink flowe rs, stands out quite conspicuously. Seen at a distance at this season, a redbud thicket might easily be mistaken for a peach orchard; the resemblance is most marked, not only in color, but also since both trees display their flowers on anked branches and have rather similar form. Redbud shows individuality by often bearing its pea-like blossoms in such unusual places as below the insertion of branches on the old wood, or even on the trunk itself. Usually they occur in clusters of 4 to 8 flowers on short stems. Their faint fragrance is sufficient to attract bees that serve as pollenizing agents.

Proper fertilization of the flowers results in thin, flat pods which in size and shape much resemble those of black bocust. That these two trees should bear similar fruits that likewise occur in dense clusters, is no mere chance resemblance since both are legumes and closely related. Young redbud pods, with their light rose color, are by some considered nearly as decorative though not as showy as the flowers. They are full grown in early summer, but remain on the tree until the following spring, at which time both pods and flowers may occur together.

Very few trees or other plants have leaves that are more perfectly heart-shaped than those of redbud. They range from 3 to 5 inches across and are rather leathery in texture. Radiating from the extreme base of each leaf are 5 prominent veins that extend almost to the smooth, entire margin. Carried on slender petioles which are thickened at either end and 2 to 5 inches long, these dark green, glossy leaves, turning yellow in autumn, make a foliage display that is always attractive. They appear soon after the flowers.

It is the small, blunt-pointed buds, covered with dark red or purplish scales, that have given to the tree its common name. The leaf buds are flattened and pressed close to the twigs, but those that contain floral parts appear rounded and often occur in superposed clusters. Another mark of distinction that is helpful, particularly in winter, is afforded by the reddish longitudinal streaks that occur in the pith of older twigs and branches. Though the twigs have smooth reddish bark, that on older stems breaks into small thin scales but seldom shows perpendicular furrows. Redbud produces a rich brown wood that takes a good polish, but is usually of too small dimensions to be of any commercial importance.

LEATHERWOOD (Dirca palustris)

This little understory shrub, usually not more than 3 to 5 feet tall, has numerous points of similarity to spice bush. In fact, so much alike are they in general appearance that in summer particularly few persons ever notice or become acquainted with leatherwood. Both of these shrubs frequent moist, shaded woodlands and often will be found growing in close association. Likewise, both bear smooth, entire leaves, of about the same size and shape, that are attached by short petioles. The foliage of each has a noticeable light green cast that later turns to a clear yellow in autumn. Their red berries too bear a close resemblance, being one-seeded drupes, but those of leatherwood mature so quickly and fall so soon as to easily escape notice. But there are many ways of differentiating the two species. By its characteristic aromatic taste and smell spice bush need never be confused with any other woody plant. Also its bright green twigs contrast sharply with the tan-colored ones of leatherwood. Probably the best way of all to distinguish between them is to attempt to break off a twig; if the twig be that of spice bush it will snap off readily, but if leatherwood that is another story.

It was from its bark that this shrub derived its

appropriate common name. "Tough as leather" is a phrase quite descriptive of such bark with its long interlaced fibres. That of no other woody plant exhibits such tenacity and strength. Thick and porous, yet soft and pliant, leatherwood bark is a good example of specialized development. Though the wood itself is quite brittle, it is safe to say that no combination of perseverence and brute strength has ever succeeded in tearing a well-developed branch from this shrub. The Indians well understood its properties for they employed the bark in making thongs, ropes and baskets.

Leatherwood is an interesting little shrub, despite the fact that it is always rather incomspicuous. While its pale yellow, tubular blossoms are not showy, it deserves to be ranked among our earliest flowering shrubs. Early in April the flowers appear, in clusters of 2 to 5 before the leaves, but they rapidly fade and fall as the foliage develops. Its leaves are carried on ascending, smooth, tan-colored twigs, thickly clustered at the ends of the branches. In addition to their tough bark, these twigs with their "jointed" or "telescoped" appearance, due to raised and near-encircling leaf scars, afford a most excellent means of identification. Another characteristic trait of this shrub is its habit of concealing its brown velvety buds under the bases of the leaf stems. The absence

of a terminal bud on any of the twigs, thus permitting random development of side shoots, accounts for its low, much-branched habit of growth.

Called also moosewood and wicopy in the North, leatherwood occurs from New Brunswick to Florida and westward to Minnesota and Missouri. Its white brittle wood has no commercial value but the plant produces an acrid juice that possesses emetic properties. If taken internally, this juice produces nausea and violent vomiting. The berries, too, if eaten, are said to be narcotic in their effect.

WINTERBERRY (Ilex verticillata)

Many persons well acquainted with our attractive evergreen hollies fail to recognize the close kinship of this little shrub called winterberry or deciduous holly of the same family. Though not quite so conspicuous as its near relatives, the holly trees of Europe and the South, nor attaining to such large size, nevertheless in proper time and place winterberry too has unmistable beauty and charm. Probably nowhere is the brilliance of its abundant scarlet berries portrayed to better advantage than when seen flaming in a dismal winter bog. When gathered and brought indoors, as is often the custom about Christmas time, the branches laden with berries lose much of their decorative value. To be fully appreciated, this or any other plant

must be viewed in its natural surroundings.

Winterberry demands lots of moisture, hence its favorite haunt is low wet woods and swamps; where it occurs in company with such other shrubs as spice bush, alder and poison sumach. It is a much-branced bush, of upright habit, and varies from 5 to 10 feet in height. When divested of its fruit it has been likened to a scrubby thornless plum tree. Both trunk and twigs are covered with a smooth gray bark, on which are prominent warty lenticels, and if chewed it will be found to be bitter and astringent. Along the winter twigs may be noticed small blunt-conical buds, sometimes superposed, and so extremely minute as to be altogether distinctive. Then too, the tiny rounded leaf scars, each containing one prominent vascular bundle, aid in identifying the plant in its winter condition. Both buds and leaf scars much resemble those of climging bittersweet (Celastrus scandens). One may find winterberry occurring commonly in marshy places from Nova Scotia west to Minnesota and south to Florida and Mississippi.

Though of most striking appearance when its fruit is present, at all seasons of the year this wild native shrub will be found to have distinctive features. Its dark blue-green foliage gives to the plant an appearance of freshness and vigor quite in keeping with its habitat and surroundings. The leaves may be known by their pointed-

oval shape, sharp toothed margins, and with prominent sunken veins on their upper surfaces. They are borne on short petioles that are grooved above and more or less pubescent. But when it comes to parting with its foliage in autumn winterberry exhibits a marked peculiarity. Instead of assuming bright colors so characteristic of the season, its leaves turn almost black as if frosted, or occasionally they fall with little change of color.

In June or early July, if one is observant he will notice clustered in the axils of the leaves many small greenish flowers. They soon develop into a pea-sized fruit, described by botanists as a berry-like drupe, and containing when ripe a yellowish pulp and numerous small seeds. Green at first, each berry later becomes orange-colored and finally a brilliant scarlet. So thick and close do they cling to the terminal twigs as to suggest the appearance of long spiked fruit clusters. Long after the leaves have fallen and well into the winter, these bright colored berries, apparently unaffected by frosts, still ornament the naked stems. Probably because of their thin flesh and bitter taste, the birds do not seem to bother them.

But the great naturalist, Thoreau, with his keen observations of natural phenomena, learned that woods mice will run up the stems in the night, gather these berries, and eat the

kernels from their small seeds. He noticed, in the middle of November, that the ground was strewn with them at the entrance to their burrows.

(c) Using the Ax in Forestry.

In most reforestation plans roads, trails, fire towers and telephone construction come first, because protection from fire is the foundation of forestry. After these are well accomplished, the best development of the forest stand must be taken up. Some people think a reforestation plan means mainly planting trees. This is emphatically not the case. Over for the largest part of our cut-over and burned forest lands generous "Mother Nature" is bringing back a natural forest This includes valuable species and "weed" species, sound straigl trees and fire, ax, or storm crippled, hollow and rot-infected trees. Lumbermen have operated so long selecting the choice trees in species and form, that the residual stand is far from the condition making for a high wood growth or a general replacement of the more valuable species. The fires following the railroads and ax of the lumbermen have worked a further harmful change in the natural regeneration. They have blotted out the coniferous pines and hemlock which do not sprout from stumps or roots, nor produce seed at an early age. The early seeding and sprouting harwoods have thus been favored by ax and fire. Some of these are of little value. Insects and fungous diseases thrive on trees in such a sub-normal forest environment.

The first steps in a forest management plan for second growth cut-over forest land then is to use the "ax of a forester". This is particularly true when the material cut can be disposed of for fire-wood, pulp or chemical wood to pay for the cost of cutting, and thus secure an improved forest stand at no net cost. Large crowned limby knotty trees ("wolf trees") that will never produce a clear saw-log, but occupy the space of a number of young trees; fire-scarred trees afflicted with heart rot; trees with fungous "cancers"; trees of weed or inferior species as scrub oak, black gum, fire cherry, soft maple, sassafras; trees with dead or badly broken tops, are marked for removal and cut out. This is called an "improvement cutting" and is a rather generally necessary early forestry measure on present state forest lands in Pennsylvania. In the last three years relief funds and the need for cheap fuel, permitted considerable improvement cutting on the state forest lands. From 1921 to 1927 about 35,000 cords of small size blight killed or infected chestnut was removed from the Mont Alto State Forest at a slight profit through improvement cuttings, here taking the form of "salvage cutting". This was made possible by a special state wood sales fund from which costs could be paid. Since 1927 this forest stand improvement work has been stagnated by the abolishment of most state special "funds" and the failure to appropriate sufficient

labor funds to continue this necessary work. The advent of the Conservation Corps again permits a stepping up of this much needed improvement of the forest stand.

In addition, plantations and dense stands of sound trees that may be all of desirable species often reach a point where there are too many trees for the light and soil moisture available. This condition is discovered by the forester through the falling off in the width of the growth rings, or the too great crowding of the better tree crowns. When forest plantations are made or mature stands are naturally regenerated there may be from 1,000 to 10,000 small trees on an acre. Only 100 to 150 of these trees can survive until saw size. The rest must be removed in a succession of thinnings. In Europe where small small sized material can be disposed of at a profit, these thinnings are rather light and made each 6 to 10 years. With us such scattered cuttings are too expensive and we thin only when the trees begin to suffer for want of light -10-to 20 years. Good forestry keeps the stand dense to shade off the young lower branches and make the trees prune themselves up about two thirds of the height of the tree.

There are a few exceptions to this - Maple sugar groves in the north and turpentine forests (or "orchards") in the south must have the trees spaced wider so as to develop

larger crowns more like apple trees. Here the sap and pine gum are the products and not clear fine grained lumber, poles, pulpwood, etc., which most forestry projects have for their aim. For those products extra early and heavy thinnings must be made. In dense stands this may become so expensive as to make the required open forest cost more than planting up open lands to 100 or 200 trees per acre.

Another case where the ax serves silvicultural ends is when the forest stand is to be replaced by natural seeding. A "regeneration cutting" is planned which may take one of several forms. For even aged forest and species that require some protection from the sun when the seedlings are small, the old stand may be taken out in the form of say two thinnings 5 to 10 or more years apart, taking about a third of the trees each time, followed by the final cutting. The first of the three cuttings admits enough light to stimulate seed production on the remaining largest crowned trees, and secures a stand of small seedlings under the protecting shade of the remaining two thirds of the old trees. As these seedlings require more light a second cutting of mature trees is made. When a full stand of saplings has developed the third and last part of the mature trees or "over-wood" is taken out.

Another plan is to remove the old trees in groups

or strips, making openings for the young trees to start in, and then enlarge these until the old trees are all out and the young trees cover the area.

These regeneration cuttings sometimes take 18 to 40 years to complete and sometimes it takes 80 to 120 years to grow a large saw-log tree. Nature is lavish in the use of time. A forester must make a virtue of patience. But by the same token he cannot afford to make bad mistakes, since correcting them is too costly in time.

Thorough training allied with forest research is therefore demanded for our rapidly developing forestry profession. These are even more necessary in handling forest lands than for agricultural lands. At present the practical training of our foresters has an insufficient basis and our research agencies must develop and test advanced methods and treatments in forest practice on a more intensive scale if we are to continue our past rapid progress. Forestry must now be transferred more from the platform and legislative halls and administrative offices, to the forest land. As agriculture ultimately depends on the "dirt farmer" so forestry ultimately depends on the "seedling and sawlog foresters".

(d) Questions.

(e) Field Trip. Mark an area near camp in advance for an "improvement cutting" using paint to show trees to be cut. Point out coppice and seedling trees. Find opening where previous cutting, or windfall has stimulated regeneration. If a plantation is near discuss density, natural pruning and thinning.

Lesson 8. (a) Pennsylvania's Land and State Forest Policy.

When William Penn accepted in 1681 a grant of land in America from King Charles II of England in settlement of a claim of 16,000 pounds sterling and the promise of a peerage due his father, Admiral Penn, he had in mind the establishment of a colony for the persecuted members of his faith - the Quakers. The King specified the proprietary domain as beginning from the Delaware river 12 miles north of New Castle and extending west 5 degrees, and from the 40th to the 43rd parallels of latitude. These boundaries were somewhat modified by later agreement between the states. The entire state of Pennsylvania may be said to have figured at a fourth of a cent per acre in the transaction. However, Penn still felt this grant gave him only the governmental rights and he and his heirs conducted successive "purchases" from the Indians. He respected titles acquired by the few Swedes and Dutch who preceded him.

In seeking settlers Penn at first sold land at 4 pence an acre - later equal to 8 cents of the new U.S. coinage, but possessing a purchasing value about 4 times as much as at present. Tenants were encouraged at a penny (English) per acre "quit rent". Wm. Penn never tried to exploit the land resource of the colony and died in modest circumstances.

His widow died almost in want. Penn's heirs assumed more of the "business proprietor" attitude. It is estimated that the proprietor extracted from the colony about 4 million pounds (over 19 million dollars) in the period of almost a century of control. This included the 120,000 pounds paid the Penn heirs to extinguish their territorial rights by the new state in 1779, the governmental and proprietary rights having been extinguished by the revolution in 1776.

The new states maintained the policy of developing its resources by disposing of its land and forest to private owners for small returns. Much land was granted soldiers of the Revolution in liew of back pay and as honorariums. Much land clothed with virgin timber passed later for 50 cents per acre.

Many of the old easily acquired forest land warrants were brought up by individuals and lumber companies and blocked together in holdings of large size and ultimately large value.

At first land too rough to clear for farming had little value, no matter how fine a stand of timber stood on it. The colonists had more timber than could be disposed of on the lower lands they wished to clear for cultivation. Gradually the timber nearly became scarcer and remnants of good timber attained a value because it entailed transport expense to secure the practically free timber further back. Certain timbers like white pine, hickory, ash and oak gradually

IRREGULAR PAGINATION

increased in value in the settlements. White pine then was rafted down the streams from the back country to the settlements for there were no roads, canals, or railroads.

Chestnut oak, chestnut and hemlock bark early came in demand for tanning leather. There was yet little market for the timber. Entire mountainsides were stripped of these trees, the bark peeled and the trunks allowed to lie and decay or become the prey to the flames of the annual spring fires. Fires ran from the choppings into standing timber in dry periods, destroying more standing timber than was cut and utilized. The entire country failed to see the relation of the timber resource to the stream and water supply welfare or to the wood demands of the population that was to multiply within a centary and a half. That there would be an end of virgin timber entered the minds of but few. One of these was William Penn, for he advised that one fifth of the land should be kept in timber. Wood was the universal fuel and he saw that the fuel supply and material for farm fences at least had to be maintained close to the point of consumption under colonial conditions.

When roads, railroads and finally the discovery of coal, made the thickly settled areas more independent of nearly supplies of firewood and building timber, forest exploitation went on apace. First the easily logged areas

along drivable streams were stripped of their conifers and floatable timber. Then railroads penetrated the more remote plateaus and divides and finally removed the undrivable hardwoods as well as the conifers remote from drivable streams. Before this practically all state owned land had been disposed of.

In the meantime European colonization, settlement, and subsequent growth of population forced there a large scale and generally successful attempt at reforesting non-agricultural soils.

A Pennsylvania, with denuded and barren mountain areas began to present itself in the late 80's of the last century. The cut over and burned forest lands began to appear in the tax delinquent lists in increasing quantities.

A group of public-spirited citizens of Philadelphia and vicinity met in 1886 and formed The Pennsylvania Forestry Association with a publication "Forest Leaves". The Association was incorporated in 1889. In 1892 Dr. J.T. Rothrock became its Secretary and began an active lecture campaign over the state to arouse the public to reverse the action of the deforestation forces into a reforestation movement. In this he was eminently successful. Dr. Rothrock led the movement until his death in 1923 and is known as "The Father of Pennsylvania Forestry". The Association backed a bill for an investigative Forestry Commission. This

was passed and Dr. Rothrock became a member. As recommended by the Commission a Bureau of Forestry in the Department of Agriculture was established in 1895.

In 1897 bills passed the legislature providing for the purchase and creation of three forest preserves of not less than 40,000 acres each on the Delaware, Susquehanna and Ohio River watersheds. Subsequent acts provided for the purchase of tax delinquent and other forest lands at a price not to exceed five dollars per acre (now 10 dollars). Thus we see that a new state policy of great future importance was born - that of permanent state ownorship and reforestation of non-agricultural land.

This same reversal of policy was taking place in the federal land field. The U.S. in 1891 began setting aside forest lands still in its original ownership for national forests. Since it still had large areas of these lands (almost all in the west) it did not become convinced of the need of buying back privately owned forest land until 1911 or 14 years after Pennsylvania had begun this work.

In 1901 the Pennsylvania Legislature saw that Forestry, including the mangement of large State Forests, was a larger and separate and distinct governmental responsibility from its aid to Agriculture. It, therefore, made Forestry a separate state department and later added waters supervision,

now designating it the Department of Forests and Waters.

The forest land purchases by this Department of Forests and Waters totaled on Jan. 1, 1933, 1,610,292 acres. These forests are placed under the administration of District Foresters with Ranger assistance. Roads are being built into these lands to give them better fire-protection and open them for the removal of wood products, as well as to furnish recreation to the people.

Three large nurseries have been established to raise young trees for planting on denuded areas in the state holdings. Trees are furnished at cost (seedlings $2.00, transplants $5.00 per M.) to private land owners who wish to reforest their land.

A state-wide forest protection system consisting of about 120 fire-detection towers, with an organization of wardens, inspectors, and fire crews, all working under the district foresters, furnishes much protection to all forest land in the state. Fire damage has been much reduced. The records still show 3,000 forest fires starting each year. Only extraordinary dry weather is needed to make a most destructive combination and lose the forest growth of years on large areas. It is evident that many of our citizens must still learn the duties of citizenship in protecting this growing forest heritage.

It is not surprising that the principal income from the state forests, largely stocked with very yound timber should at present be from the approximately 3000 camp site leases. The rapidly growing number of permanently built camps is just a small measure of the recreational use made by the transient picnickers, tent campers, hikers, and automobile tourists.

But this is not the complete state forest policy. Another branch of the state government utilizes the forest principally as the basic resource for game production and management. The State Game Commission purchases lands for game preserves and public hunting grounds - now from the hunting license fees. To Jan. 1, 1933 it has purchased for the state 322,891 acres of forest land. The hunting license fees now bring in about one and one third million dollars a year, and Pennsylvania has become a mecca for big game hunters. In 1932 there were 19724 deer and 216 bear killed in the state, besides large quantities of smaller game.

Fishing licenses also bring in about a half million dollars a year. Both these outdoor pastimes reflect the volume of recreation made possible by our forests. Without forests there would be little hunting and fishing.

The state is seen to be slowly rebuilding a forest resource of large size. It will eventually be able to

restore raw wood materials to industry on a large scale, improve the waters of the state, and furnish recreation and sport to our people with increasing leisure to enjoy the forests.

The state pays local governments 5 cents per acre and year in lieu of forest taxes. As the income from the forest lands again increases no doubt the local government bodies will receive larger returns. On the other hand, all gorest receipts go into a special school fund so that we may say all the forest earnings go to support government functions even now.

There are few states with as far reaching a forest policy as Pennsylvania. New York has about 25% more state land, but this is held for park purpose entirely and cannot be managed for timber production under its constitution. Some of the lake states are acquiring large areas of tax delinquent cut over lands. Some western states have exchanged scattered state school sections for solid tracts of national forest land of equal value and created state forests. On the whole, state governments are not meeting their responsibility toward the forest lands beyond private powers to restore.

A later discussion of idle and tax delinquent lands in Pennsylvania will make it clear that the state or

counties will be forced to take over at least another million acres of forest and idle farm land. In addition to the tax delinquent land there are several million acres of mountain forest that must come under state control if it is to be properly protected and reforested. In all the state should own 6 of our 13 million acres of forest land with perhaps a half million more in national forests.

(b) Tree and shrub identification: broadleaf simple alternate leaved trees; native cherries, juneberry, black gum: shrubs - huckleberries (vaccinium), arbutus.

THE CHERRIES (Prunus sp.)

There are in the world about 90 species of woody plants belonging to the genus Prunus. Included in this group ard mostly the cherries and plums. They range in size from shuubs to large trees. Most of them are native to the North Temperate zone, some in tropical America, and a few in Asia. Seven species are said to occur in Pennsylvania, only four of which may be considered common:

Members of this genus always bear their simple, usually serrate leaves, in alternate arrangement on the twigs. The white or pink flowers are perfect, 5-parted, and variously clustered: often showy and fragrant, they appear in spring or early summer. Their fertilization results in a one-seeded, fleshy drupe. The stony seed may be round or oval and flattened: the fact that they are not injured by passing through the alimentary canal of animals aids in their wide dispersal. Most species have odible fruits and in many instances these have been so improved by man as to become of commerical importance.

Winter distinction is afforded by the alternate

buds with sclaes overlapping in several rows. Contained in each leaf scar are 3 distinct vascular bundle scars. Then too, most species may be known by their bitter and aromatic inner bark.

In Pennsylvania, only one species of this group, namely the wild black cherry (Prunus seotina), reaches a size sufficient to produce wood of much commercial value. But, in addition to it, two other interesting and common species of cherry will be considered in this lesson. They are the fire cherry (Prunus pennsylvanica) and choke cherry (Prunus virginiana). These three native cherries of Pennsylvania may be separated as follows:

IN SUMMER

1. Flowers in terminal racemes; appear after the leaves..... 2.

1. Flowers in flat-topped lateral clusters; appear before or with the leaves ..... 3.

2. Leaves long, narrow, taper-pointed: serrate with short incurved stout teeth; ripe fruit black, tasty ..... Wild Black Cherry

2. Leaves usually oval, abrupt-pointed; serrate with spreading slender teeth; ripe fruit dark red, astringent ..... Choke Cherry

3. Leaves like wild black cherry, but more delicate; ripe fruit light red, sour ..... Fire Cherry

IN WINTER

1. Buds clustered on ends of twigs; twigs glossy bright red, slender ..... Fire Cherry

1. Buds rarely clustered; twigs brownish, rather stout ..... 2.

2. Twigs thickly spotted with round white lenticels; mature bark with black roughened plates; attains large size ..... Wild Black Cherry

2. Twigs sparsely covered with orange-colored lenticels; mature bark brown and rather smooth; of shrubby appearance ..... Choke Cherry

WILD BLACK CHERRY (Prunus serotina)

Ranking commercially among the most important hardwoods of this country, wild black cherry too deserves credit as being our largest, most widely distributed and possibly best known wild fruit tree. It covers a tremendous area in eastern America, reaching from Nova Scotia westward through the Canadian provinces to North Dakota and southward to Florida and Texas. Though not all botanists are agreed, this tree or a variety of it continues on down through Mexico, Central America and, crossing the equator, extends even as far as Peru on the west coast of South America. It is claimed to have attained its largest size on the fertile slopes of the high Allegheny Mountains from West Virginia to Georgia.

Despite its wide distribution, however, this

species occurs sparsely, seldom or never in pure stands, and most often as individual trees or small clumps of them scattered sparingly through the forests. Even in former times, when virgin timber was plentiful, only rarely and locally did black cherry ever become common. Generally associated with that group of trees known as the beech-birch maple or northern hardwoods type, it was from such stands, in which grew also beech, sugar maple, white ash and basswood, that the largest and finest original cherry was cut. It requires good rich soil and close forest stands to produce the tall, shapely veteran trunks which yielded the choice cabinet wood for which black cherry has long been noted. Like black walnut, tulip and others that formerly occupied the best ground, this tree suffered severely when our country was cleared for agriculture. Thereafter, because of its value, lumber men cut it so heavily that today good wild black cherry is extremely scarce.

Through the agency of birds, which have scattered its seeds far and wide, this tree may now be found growing in many situations to which it is poorly adapted. It frequently springs up along fence rows, roadsides, and in other waste places. Such trees, however, being usually short and limby, are of little or no value for lumber. Though black cherry is a light-demanding tree, like most others of

that type it seldom amounts to much when open-grown, the best timber resulting rather from dense stands wherein each tree must lift its crown high on a slender trunk to reach the sunshine. When growing thus in the original forest, this species often attained a diameter of 36 inches and sometimes was more than 100 feet tall, with a long, clean trunk that tapered but little, and bearing aloft a small narrow crown composed of slender horizontal branches.

The bark of wild black cherry possesses interesting characteristics and properties. On young trees it has a smooth, glossy, reddish brown appearance, sometimes peeling off in thin, film-like, translucent layers. Over its close-fitting surface occur lines of light-colored, horizontally- elongated lenticels or breathing pores that stand out conspicuously. A knife blade easily penetrates the thin outer shell, which if stripped back reveals a bright green, spongy inner layer. With age, this smooth outer bark becomes almost black and much roughened by thick irregular plates having characteristic curled-up edges. Though wild cherry bark does, in general appearance, suggest that of black birch, the latter can be separated on the basis of its darker, less elongated lenticels, the more flattened bark plates on older trees, and unquestionably by its strong wintergreen flavor. Wild cherry bark is intensely bitter

to the taste and when bruised has a typical odor, due to its hydrocyanic acid content. If collected in the fall and dried, it has medicinal value, with tonic and sedative properties said to aid in the treatment of pulmonary complaints. As a home remedy, it formerly ranked with sassafras bark in the "spring tonic" of our grandmothers. Some modern cough medicines still contain this ingredient.

Probably the average person who knows the wild black cherry is best acquained with it as seen growing commonly along fences and roadsides and in open fields. There it develops a spreading crown of slender drooping branches that, together with its usually crooked or inclining trunk, make the tree easily recognizable even at a distance. Then, too, limbs and twigs of this tree often carry unsightly swollen growths, caused by a fungus (Plowrightia morbosa) known as "black knot". So common and conspicuous are these large, black, encircling cankers on wild cherry branches as to furnish when present a helpful means of distinction. The smooth brownish twigs, in addition to being thickly spotted with round white dots, are invariably more or less covered with a thin, film-like, grayish skin which is easily rubbed off. They, like all other features of the tree, have if chewed a characteristic taste quite like that of bitter almonds.

If you have noticed, black cherry is one of the very first trees to unfold its leaves in spring. For a short time then the peculiar light green of its developing foliage mass is a conspicuous part of the rural landscape. At maturity its long, narrow, shining green leaves, each with fine-toothed margins and prominent midrib, droop from the twigs in a typical fashion. They appear to be concentrated largely on the woody growth of the previous season, hence their massed effect, when viewed from a distance, gives to the crown a rather thin, open appearance that is quite characteristic of the tree. But the leaves of this wild native cherry are never clustered on the ends of short, spur-like twigs as are those of our domesticated species. Curiously enough, black cherry foliage when wilted forms a deadly poison known as prussic acid: if cattle eat these wilted leaves, serious results usually follow. Unfortunately this tree serves as the favorite host of a serious defoliating insect, known as tent caterpillar. Its egg masses are deposited upon the twigs, chiefly of apple and wild cherry, early in the summer. They are dark colored, glue-like objects encircling, or "saddled upon" the twigs, and most of these egg clusters are about half an inch long. There they remain throughout the summer and winter months, their

presence affording the tree student another helpful distinguishing feature. About the time the leaf buds begin to open in spring, the young newly-hatched caterpillars start feeding upon the expanding foliage. Their white silky tents, which they spin in the forks of the branches, are both common and conspicuous objects on wild black cherry.

In May or early June appear the attractive clusters of small white flowers, all the more showy because then arranged against the mature dark green foliage. They are borne in elongated cyllindrical racemes on the ends of the leafy shoots. At first they stand erect or inclined upwards, but later droop under the weight of the developing fruit. The berries when ripe are a lustrous black, about the size of a pea, juicy, and with a vinous, although not disagreeable taste, but unless thoroughly ripened they are rather bitter. Not until late summer, about the time that blackberries are being gathered, is the fruit of the wild black cherry really edible. Then it is that open-grown trees, which usually bear abundantly, attract many birds to the feast, notably such members of the thrush family as the robin, catbird and brown thrasher. Many a country boy too has learned to relish these black juicy globes. From the time that the old settlers among the Alleghany Mountains acquired the knack of making their famous "cherry bounce"

even down to these latter prohibition days, people of rural communities have always prized the fruit of wild black cherry for the making of home beverages of various tonic and intoxicating properties.

Next to black walnut, wild cherry has the reputation of being the highest priced lumber produced in the United States. Being strong, fine-grained, and with a satiny surface that polishes well, its rich chestnut-brown color very much resembles that of mahogany. In fact, black cherry wood frequently masquerades as mahogany in furniture and interior finish, uses for which both those valuable woods are almost exclusively employed. Formerly it was common practice to make furniture of solid construction, and often of only the choicest heartwood. Nowadays, due to the scarcity of old growth timber, the more valuable woods are cut into thin sheets of veneer and glued to the surface of a central core consisting of cheaper material, thus making what is known as "built up" rather than "solid" cabinet work. Practically all black cherry of first quality now goes into veneer. Its scarcity, together with the fact that it may easily be raised from seed, is not difficult to transplant, and makes rapid growth, are all good features that recommend this tree for forest planting, but only on good rich soils where it may be grown successfully.

CHOKE CHERRY (Prunus virginiana)

Country boys and girls who have roamed the woods and fields need no introduction to this common tall shrub of fence-rows, roadsides and margins of the forest. To them it is a popular favorite, particularly in early autumn when draped with hanging clusters of luscious dark red fruit. But only the knowing ones have solved its secret, for the bush is well named. Of course, green at first, the young cherries soon become yellow or maybe red-tinted, then next assume in late summer a bright red translucent appearance that deceived the unsophisticated into believing they are ripe. Indeed at this stage of development, when they much resemble ripe currants, the thick drooping clusters do look quite appetizing. But the one who attempts to eat these half-ripe fruits, with their harsh, bitter, astringent taste, is fully informed as to the why and wherefore of the name "choke cherry". Later, however, when almost black and fully ripe, though they may pucker the mouth and darken one's teeth somewhat, choke cherrie are then quite juicy and of a peculiar rich flavor that is altogether agreeable.

While the choke cherry has been classed among our tree species, it more frequently is with us an erect shrub of variable height that may occasionally attain to small tree size. It is said to reach its best development in the

Southwest where sometimes it becomes forty feet high and a foot in diameter. But despite its modest proportions, this species covers more territory than any other of our native cherries, all of which are widely distributed. Indeed, by some authorities it is regarded as having more general occurre than any other of our native American trees. Reaching from Newfoundland, through Labrador to the shores of Hudson Bay and westward, across the entire continent, to the Pacific coast of northern British Columbia, it covers a tremendous area in Canada alone. Within the United States, it is believed to occur in every state east of the Mississippi River, excepting possibly Florida, and also those states bordering the west side of the above-mentioned river, Texas, and northern Mexico. So frequently does it spread by means of root suckers that choke cherry t ickets commonly exist wherever this species is found to occur naturally.

In summer one may recognize the choke cherry by its dull green leaves that are either oval or obovate in outline, abrultly short-pointed, and with very finely sharp-toothe margins. Like those of the tame sweet cherry, to which they bear a close resemblance, each leaf is distinctly widest above the middle, with generally two small greenish glands located near the top of the leaf stalk. Also they are smooth, of rather thin texture, and have characteristic spreading teeth

that help one to identify them. They turn a bright clear yellow in the autumn before falling.

To approach a choke cherry thicket in May when the flowers are out is always a pleasant incident of a day's ramble afield. Of dainty appearance, the thick white cylindrical spires deck the branches so profusely as to almost hide the foliage. They fill the air of the immediate neighborhood with a peculiar odor that attracts great swarms of insects of all kinds. The way they clamber over the blossoms with their protruding stamens would lead one to surmise that no individual flower could possibly escape being pollenized. But, for some unknown reason, it is difficult to find a perfect fruit cluster; usually they are somewhat straggly in appearance, with numberous stems missing from their respective positions. Of course later, as the cherries ripen they are eagerly sought by birds, but then the stems remain as evidence of their former presence. Possibly it is a habit of the choke cherry to bear some sterile flowers in each of its elongated clusters.

Both flowers and fruit in their general appearance much resemble those of the wild black cherry, though the latter usually attains to larger size before attempting to reproduce its kind. But they may be separated too on the basis of the less exserted stamens within the blossoms of

choke cherry, the fruit of which also carries no persistent calyx in any stage of its development. Furthermore, it will be found that no other of our native cherries bears a fruit of such peculiar astringent quality. It is claimed to have been an important article of food among the North American Indians.

Winter recognition is afforded by the grayish brown bark covering trunk and branches, the inner layers of which give forth a strong characteristic odor. Dotting its otherwise smooth surface occur many raised orange-colored lenticels. The twigs average stouter than those of wild black cherry, differing also in not being covered with any gray filmy skin which on the latter may be easily rubbed off. Its larger and more conical buds have gray-margined scales that constitute a reliable feature throughout the winter months.

Due to its small size choke cherry may be regarded as of little or no commercial value. Nor is it to be recommended for ornamental purposes as this species probably more than any other member of the genus becomes disfigured by black knot, a curious disease that may cause serious damage to cultivated cherries and plums if planted nearby. But in its natural environment it is deserving of protection, not only because it is an interesting and

attractive little tree with fruit of value to the birds, but also because it prepares the way for the extablishment of other more important tree species.

FIRE CHERRY (Prunus pennsylvanica)

The fire cherry, known also as wild red, bird or pin cherry in various localities, often has, like choke cherry, a habit of growth as well termed shrubby as tree-like. But the fact that it seldom rises from the ground with a group of stems nor root suckers profusely as do most shrubs, permits the fire cherry to be rated usually as a small tree 12 to 20 and rarely as much as 40 feet high. With a main stem that generally continues undivided through its thin crown of delicate ascending branches, this cherry is to be recognized as one of slender outline. It bears a light reddish brown, shining bark conspicuously marked with elongated, orange-colored lenticels, the raised surfaces of which appear powdery. Its thin bark too peels off in film-like horizontal strips as does that of all the cherries, exposing thereby a green inner layer which is bitter. The glossy, bright red twigs, more or less spotted with small, round orange-colored lenticels, have not only a bitter taste but a peculiar odor as well. In winter this cherry may be always identified by its terminal buds which invariably appear in a cluster of lateral buds on the end of each twig.

When clothed with foliage it is well to remember that the fire cherry bears a rather marked resemblance to our cultivated peach trees. Its long, slender, often sickle-shaped leaves, of a lustrous light yellow green, and with acuminate tips and margins that are finely and sharply toothed, indeed differ but little from those of its near relative. While usually appearing solitary or in pairs of alternate arrangement along the slender trigs, they too sometimes occur clustered on stubby lateral spurs as is true also of the peach, as well as pear, apple, plum, and introduced cherries. To make this similarity even more pronounced, both trees have the characteristic habit of curling and drooping their leaves so as to counteract the effect of midsummer heat. In autumn, the foliage of the peach commonly turns yellow; that of the fire cherry, while it may be yellow, more often becomes a bright red.

From May to July, depending on latitude and elevation, appear the tiny white flowers in long-stemmed lateral clusters amont the developing leaves. They follow closely those of the shadbush and may be seen about the time that the flowering dogwood is in bloom. Their delicate character and the fact that they often fairly cover the branches tend for a brief time to contribute a graceful appearance to this otherwise slim and scrawny tree. Whereas

the wild black and choke cherry bear their flowers in terminal racemes, on this tree they stand each on a separate stalk and grouped together in umbels of 3 to 7 along thesides of the twigs. Their odor, though faint, is sufficient to attract bees and other insects which serve as pollenizing agents.

Along about August the cherries ripen, which by that time have become a bright translucent red and appearing all the more brilliant as seen massed among the green leaves. Tho not as large as buckshot and with an extremely thin flesh, many birds relish them, sour and bitter as they are, and feed on them almost exclusively while they last. Whole flocks of them often congregate where these trees were plentiful, strip them of their fruit in a few days, and then move on to other areas. Incidently, too, by dropping its seed far and wide, birds have extended the range of the tree from Newfoundland westward thru Canada to the eastern slopes of the coast range in British Columbia, southward along the Rocky Mountains as far as Colorado, thru the Lake States, New England, and along the Appalachians to Georgia. Tho essentially northern in its distribution, it is claimed to reach its largest size among the Big Smoky mountains in North Carolina and Tennessee.

Fire Cherry is an appropriate name for this tree. Like scrub oak, aspen and pitch pine, it appears commonly on forest lands that have been laid bare by fire or lumbering or both agencies combined. Immense areas of such fire-swept and denuded lands still exist in parts of Canada, the Lake States, and principally in mountainous regions elsewhere. There the fire cherry is one of the first trees to appear, often covers considerable ground, and not infrequently takes complete command of the situation. But its reign is short-lived for such lands, if given proper protection from forest fires, wi gradually be taken over by more valuable tree species. Though fire cherry makes rapid growth, very seldom does it reach large size or become more than about 30 years of age. Its inability to withstand shade causes it to succumb quickly when over-topped by other trees. Thus, while of little value for lumber or even for fuel, this small cherry serves a useful purpose by quickly covering and thereby protecting devastated areas from erosion, and later, by means of its leaf litter, aiding and improving soil conditions. At the same time it is sheltering the seedlings of other useful species that are eventually to replace it. It is truly a pioneer tree that prepares the way for others.

JUNEBERRY (Amelanchier canadensis)

The juneberry, known also as shadbush, service-berry, and locally by various other names, ranks high among our relatively few tree species that have really conspicuous flowers. Of these, it is the first to bloom, in early spring; about the only others of our eastern trees to precede it are the elm, willow, silver maple and alder, and they attract little attention. Near the first of April, when most other trees are yet bare of leaves, it unhesitatingly puts forth its showy white bloom, and too in the most lavish profusion. Transformed into masses of billowy white, its scattered growth then prominently dots the distant hillsides or may be readily seen through the leafless woods. The flowers droop in long loose clusters, each individual about an inch across and with five narrow petals and numerous yellow stamens, much like those of our cultivated berries. Invariably they appear while the young leaves, folded lengthwise yet, are still densely coated with white silky haris. Those who know the juneberry have come to regard its floral message as a true harbinger of spring. The early settlers called it shadbush because they noticed it bloomed about the time that shad were ascending our tidal rivers to spawn.

This is another miniature tree of rather straggling habit that by some authorities is classed among the shrubs. Its

territory extends from Newfoundland to Minnesota and south to Florida and Louisiana. It occurs scattered through the understory growth, generally of open woods, and rarely forms pure stands or even becomes abundant except in restricted localities. Like so many other of our eastern trees, juneberry attains its largest proportion in the southern Appalachians. Usually it is characterized by a trunk that is slender or even spindly and surmounted by a small narrow crown of dense interlacing branchlets. Its smooth dark gray bark, prominently variegated with brown longitudinal streaks, is rather distinctive, resembling that of no other of our common trees.

The best bay to identify this tree in winter is by means of its slender twigs and buds. The twigs vary from bright green to purplish brown and at maturity are smooth or sometimes overlaid with a silvery film. But the buds are the most outstanding feature, being very slender, very sharp pointed, and with the tips often curved as well as pubescent. The terminal buds average about a half inch long and, while usually of the same color as the twig, are frequently tinged with red or purple. In shape and to some extent in size they suggest those of the beech, though the latter are larger, with at least twice the number of bud scales, and too are distinctly tan-colored. If one cuts a juneberry twig, it will be found to contain a small greenish pith, which in cross section appears five angled.

The leaves are easily recognized. It is possible

though that the uninitiated might confuse them with those of black birch or ironwood, about the only other genera to which they bear even a superficial resemblance. They differ from those mentioned by their abrupt apex, tendency toward an elliptical shape, and with fine single-toothed instead of doubly-toothed margins. Nor do the veins stand out so prominently; in fact, the very thin midrib and fine primary veins on juneberry leaves are quite inconspicuous. They are carried on petioles about an inch long, which often appear tinged with red. Usually they turn a bright clear yellow in autumn.

Juneberry was so named on the supposition that it ripened its fruit in the month of June. But that depends entirely on where the tree is found growing. For instance, down in Alabama and Louisiana it blooms in latter February and the berries ripen early in May. Towards the northern limit of its range, in the Canadian province of Ontario, the fruit isn't fully ripe until the end of July. Only in the middle Atlantic and neighboring states is the tree actually deserving to be called juneberry for there it does invariably hold true to its name.

In size, shape and appearance the berries remind one of a large huckleberry. When fully grown in early summer they appear bright red but become purple and covered with a bloom

when ripe. Each contains from five to ten very small brown seeds. The person who eats them in their red state of development would find them to be rather dry and tasteless. Though never very juicy, when quite ripe they apparently undergo a chemical change that makes them sweet and pleasant flavored.

Judging by the profusion of blossoms one would naturally expect an abundance of fruit. But such is seldom the case unless the tree should be found growing under the most favorable circumstances. Only when given open sunlight and plenty of room for development does it bear prolifically and then with the slender branches sometimes bending beneath the weight. More often they are produced sparingly and the birds, knowing a good thing when they see it, get the major portion of the crop. The black bear too is fond of these berries and despite their small size he considers them worthy of prompt attention and gathers them industriously while they last.

The dark brown wood of juneberry is heavy and very hard and strong. In fact, it has been found to be stronger, stiffer and heavier than white oak. But its scattered distribution, together with its usual small size, prevents the tree from being of any value for forest products. It probably will never be more than a minor species in the lumber industry of the United States. When used for ornamental purposes, as

it frequently is, juneberry has special value because of its conspicuous flowers and fruit which attracts many birds to the immediate neighborhood.

BLACK GUM (Nyssa sylvatica)

Black gum is a medium to large-sized tree that prefers rich moist soils, being commonly found growing on the borders of swamps, rivers and ponds from Maine westward through southern Ontario to Michigan and southward to Florida and Texas. It also will grow on dry mountain slopes, often appearing in dense stands on areas that have been burned repeatedly, but on such sites it is short-lived and scrubby. Usually the tree may be known by its bark which on immature specimens appears grayish and flaky, with shallow longitudinal furrows. But on old trunks it becomes darker in color and quite deeply furrowed, the ridges breaking up into angular blocks with prominent fissures between. This mature rough bark, with its somewhat "alligator" pattern resembles that of no other tree except persimmon. Other names for black gum include sour gum, pepperidge and tupelo.

When once seen and identified, black gum should be easily recognized afterwards. It is one of our relatively few trees that have a really distinctive form of growth. While its general outline always appears quite irregular, and also

differs with age and environment of the tree, it may invariably be told by its manner of branching alone. Generally the trunk continues undivided well into the top, with rapid taper and more or less crooked. On young and middle-aged trees, some of the lower branches may droop somewhat or the upper ones be ascending in habit, but the majority assume a distinct horizontal arrangement. Seldom of very large size, the branches usually remain short and slender, are exceedingly numerous, and bristle with stubby, spur-like lateral twigs. It becomes characteristic of old trees if not crowded to develope shallow, flat-topped, unsymmetrical crowns that give them a rather picturesque appearance. If its outline were more regular and not so straggly, black gu, would have a form and mode of branching much like that of pin oak.

While the leaves occur in alternate arrangement, most of them seem to be crowded at the ends of lateral branchlets. Their shape varies from oval to obovate, with an entire margin, abruptly pointed tip, and a length of 2 to 4 inches. They have at maturity a rather thick firm texture and a dark lustrous green color, also a prominent midrib. It is in autumn, however, that the foliage of black gum appears most conspicuous. It then ranks with flowering dogwood, sweet gum, sassafras and red maple, a

group of trees with truly brilliant antumnal coloration. But black gum precedes all others; as early as latter August its leaves commence to turn color. Shades of purple first appear, brightening into crimson or scarlet before they fall. Often one half of the leaf may turn color while the other portion remains green. Later this tree more invariably shows a mass of unmixed crimson than probably any other species. Another peculiar habit is that only their upper surface is brilliantly colored; though they may become a faint pink or gray beneath prior to falling.

The flowers of black gum are numerous, greenish yellow and inconspicuous, and appear during May or June. Staminate and pistillate occur separately, in small stalked clusters in the axils of the leaves and along the sides of terminal twigs. But only from one to three flowers of each pistillate cluster mature into fruit. When ripe, in late September or October, the ovoid, berry-like drupes, each about a half-inch long or less, are a dark blue to black, sour and astringent. These small fruits contain a bony seed covered with a thin flesh and occur grouped, one to three together, on the ends of rather long pedicels. It has been claimed that when mellowed by frost they lose most of their acrid taste. However true that may be, few if any wild creatures, unless it be some half-starved migrating

birds, are known to utilize them for food. They seem to disappear within a few weeks in autumn.

Twigs and buds afford helpful features for winter identification. The twigs vary from gray to light brown but usually have a pink or flesh-colored tint that is quite characteristic. If cut lengthwise they show, when closely observed, many woody cross partitions in the pith. Probably the most noticeable fact about the small buds is the way they diverge from the twigs. But beneath each bud will be found a crescent-shaped leaf scar in which appear three conspicuous bundle-scars that aid one considerably when the leaves are off. Then too, the short stubby twigs that project from the sides of more rapidly-grown shoots are quite typical of this tree.

Ever since land was first cleared for agriculture in this country, black gum has had a reputation for its tough wood with interlaced fibres that make it almost impossible to split. Formerly wire fences were unknown and all were made of split rails. But the early settlers soon became familiar with the qualities of black gum and instead split their rails from such other trees as oak, chestnut and walnut. About the only use they could find for the hollow trunks of old gums was to saw them into short lengths and make bee-hives or barrels out of them. Later, however,

its toughness and non-cleavability made this wood useful for such special purposes as hatter blocks, butcher blocks, mallets and mauls, wagon hubs, mine rollers, ox-yokes, and even for rolling pins and potato mashers.

The wood is rather soft, heavy and fine grained, only moderately strong; nor is it durable in contact with the soil. It too is difficult to season and checks badly if not properly handled. Most black gum lumber is used in the rough, for floors, sheathing and frames. Its white color makes it a desirable wood for cheap veneer baskets, boxes, and berry crates. Other uses include excelsior, woodenware, and pulpwood.

TRAILING ARBUTUS (Epigaca repens)

Almost everybody knows the trailing arbutus or mayflower, one of our prettiest and most popular wild flowers. Not all, however, realize that this prostrate, semi-herbaceous plant deserves in reality to be classed among the shrubs. But, like teaberry, it bears woody stems which creep along the ground, just beneath the leaves. At intervals of several inches along these jointed stems are produced bunches of fibrous roots and also short ascending flower and leaf-bearing shoots. This habit of growth is reflected in its scientific name, (Epigaea repens) which, when translated into English, means "trailing upon the

ground". The plant occurs in spreading patches in rather dry open woods, on partly shaded banks, and in old abandoned upland fields. It thrives best on north slopes and prefers a light sandy or gravelly soil of acid reaction. One usually finds these clumps of arbutus associated with moss and almost covered with leaves. Because of its prominence in New England history, poetry and literature, many have acquired the impression that the mayflower is distinctively a product of the north-eastern states. As a matter of fact, it ranges from Newfound-land almost to southern Alaska, through the Lake States, New England, and follows south along the Appalachian Moun-tains as far as the sand-hills of the Carolinas and Georgia. Only one other species is known to occur in the world and that grows on the volcanic mountain slopes of Japan.

Trailing arbutus bears alternate leaves which seem rather crowded along its short side shoots. From color and general appearance only, one would hardly suspect them to be evergreen, but their somewhat leathery texture bespeaks a kinship to others of that type. Though variable in size and shape, they tend to be elliptical, with ciliate margins, and average from one to two inches in length. Midrib and reticulate veins appear to be impressed on the smooth upper leaf surfaces, whereas their lower sides and also the short petioles are covered with long rusty haris often with glandular tips. Its

brown dead leaves cling to the stems for long periods of time.

Arbutus is well known for its pretty and delicately fragrant flowers which appear so early as to well warrant its reputation as being one of the very first floral harbingers of spring. But while deserving to be classed among our earliest spring flowers, it never blooms quite so soon as some would like us to believe. Local gossip and even printed pages have sometimes set forth what seem like questionable claims, attesting that these flowers have been gathered even before snow had entirely uncovered the plants. Such flights of imagination, while they may be tolerated as poetic license, usually fall short of the actual truth of the matter. It more often happens that these early flower hunters bring home their bouquets, place them in water, and the heat of the indoors causes the buds to finally open. Or belated snow-storms may occasionally cover arbutus when in full bloom, but it is indeed questionable if the flowers ever push out from the edge of a melting winter's snowbank as some have imagined. Ordinarily they appear during the months of April or May, depending on latitude, and seldom before warm spring weather has arrived.

The flowers of trailing arbutus exhibit various shades of color, ranging from pink or almost red to a pearly-white. They occur in sessile, axillary clusters at the ends of the branchlets. Each tubular corolla is five-lobed, smooth

on the outside, but quite hairy within. Its flower buds, formed the preceding August, stand in readiness to swell with the first premonitions of spring. As soon as weather permits these scaly buds open and the flowers peep out from beneath their brown covering of leaves. Then it is that balmy spring days lure an army of hikers to the woods and mountain trails, many of whom return with large bunches of arbutus. Others even gether it for commercial purposes where state laws permit or are not rigidly enforced. If only the lateral sprigs be carefully removed little damage results to the plant. But the flowering shoots being short, often the plant is torn up by its roots. Its woody stems make sucy slow growth that when disturbed and torn needlessly it becomes unable to survive such harsh treatment.

Dr. E.M. Gress, state botanist of Pennsylvania, in his bulletin entitled "Preservation of Wild Flowers," had this to say about plants needling protection: "A long list of spring and early summer flowers might be given which were formerly common or abundant about the city but which are rapidly becoming rare or extinct through careless gathering which often amounts to vandalism, the flowers being ruthlessly pulled only to be soon thrown away. Such a list includes trailing arbutus, the various trilliums, dogs' tooth violet, lungwort, marsh marigold, blue phlox, columbine, fire pink,

the various forms of lilies, lupines, and so on for perhaps twenty or thirty species." Pennsylvania, however, has a law which places a fine of $25.00 and costs of prosecution for each tree or shrub or parts thereof standing on the land of another that is cut down, injured, destroyed, removed, or from which the bark has been cut. It is to be regretted that his law did not include also some of our rare herbaceous plants that need to be protected from extermination.

Throughout New England and locally elsewhere, trailing arbutus is commonly known as mayflower. It is said to grow abundantly along the edges of woods about Plymouth, Massachusetts, where the Pilgrims landed from their ship, the Mayflower. Presumably, this tiny wild flower was the first to greet the storm-beaten crew at the conclusion of their first terrible winter on that bleak and foreign coast. Accordingly, they or their descendants reverently named it after the vessel which bore them safely to the shores of a new world. Even today, because of its historic background, people of New England hold this plant in high regard and give it careful protection.

BLUEBERRIES AND HUCKLEBERRIES (Vaccinium and Gaylussacia Sp.)

These two genera, belonging to the heath family (Ericaceae), together include some 140 or more species of

plants of wide geographic distribution, but most prevalent in the northern and western hemispheres. Though distributed from boreal regions to the high mountain of the tropics, North America has probably more species than any other continent. Our representatives seem to be concentrated east of the Rocky Mountains and at more northern latitudes. Not all are called blueberries and huckleberries, however, for the genus Vaccinium includes also three other groups known as bilberries, whortleberries and cranberries.

The name huckleberry is often applied in a general way to include the fruit of all species of the two genera, Gaylussacia and Vaccinium. More properly it belong to members of the former genus, those of the latter being designated as blueberries. There is a tendency, in the markets at least, to call those berries which are black and shining huckleberries and the blue ones blueberries. Actually the taxonomic differences between these two genera appear slight and lie chiefly in the structure of the ovary. The fruit of Gaylussacia is ten-celled, and with one seed in each of the cells. That of Vaccinium contains from four to five cells and in each are several seeds. But while the true huckleberries (Gaylussacia Sp.) bear fruit with fewer seeds they actually are the more bothersome to eat, because the ten seeds within each berry are more or less solidly grown together. Huckleberries too have clammy resinous sclaes on the undersides

of their leaves which do not appear on any of the blueberries.

Taken collectively, the two genera differ so little in habits and appearance that they first will be discussed together in a general way. Great variation of form and size exists between species, ranging from semi-herbaceous to woody, prostrate to erect, and from shrubby to tree-like. Some species grow on the dry rocky slopes and summits of mountains, while others prefer swamps and bogs. Most of them, however, have a partiality for siliceous soils of an acid reaction, so much so in fact that their presence serves as an excellent but not infallible indicator of such. It is though a rare incident when one finds them or any other member of the heath family making anything approaching a vigorous growth on soils of limestone origin. They bear simple, alternate leaves which vary from ovate to oblong or elliptical. Incidentally, their leaves do not seem to be poisonous as are those of some others of the family. Though a number of evergreen species are included, only one, the very rare box huckleberry (G. brachycera), is native to Pennsylvania. The small, perfect flowers, with bell-shaped pink or greenish-white corollas, are 4 to 5-parted throughout and have twice as many stamens as what there are corolla lobes; they usually appear in terminal or lateral racemes, but in some species may be solitary in the axils of the leaves. Both genera bear small, fleshy, berry-like fruits, with persistent calyx-lobes, which ropen, in our latitude, from June to September.

THE HUCKLEBERRIES (Gaylussacia Sp.)

Two species of huckleberry occur in Pennsylvania, which may be distinguished as follows:

> Grows either on dry slopes or in swamps; leaves thin and delicate, glaucous and with tiny specks of resin below; flowers and fruit in loose drooping racemes; berries dark blue with a glaucous bloom ... Dangleberry (G. frondosa).
>
> Found on drier soils, seldom in swamps; leaves smaller and tougher, not glaucous beneath but densely covered with resinous scales; flowers and fruit singly or in small clusters; berries black, shining, without bloom ... Black Huckleberry (C.baccata).

It is difficult to distinguish between species of either Gaylussacia or Vaccinium in their winter condition.

Both dangleberry and black huckleberry are erect branching shrubs which average about 3 feet tall, although the former, if growing in moist places, may occasionally attain to 6 feet in height. Its large pale leaves and scanty campanulate blossoms and fruit on slender pedicels make it easy in summer to distinguish dangleberry. Black huckleberry has much smaller leaves of yellowish green tint above and resinous beneath. Despite their seediness, the fruit of these two huckleberries are gathered in enormous quantities.

Picking huckleberries is a mid summer great industry of some rural districts. They are sent either raw

to the markets, or to canning factories. Also the berries provide a favorite fruit for local consumption. It is said that the Indians were fond of huckleberries, which they often dried and sometimes included in pemmican.

In the past, it has been a too common practice to burn over periodically large areas of mountain land so as to improve the huckleberry crop. When mowed or burned the bushes do sprout up and produce, in a year or so, an abundance of berries. Such practice, however, on potential forest lands, cannot be too severely criticized for it robs the soil of its fertility and makes it difficult if not impossible to ever again grown a crop of merchantable timber thereon.

THE BLUEBERRIES (Vaccinium sp.)

Five common species of blueberry occur in Pennsylvania, tho several others are native to the State. They may be distinguished in summer by the following key:

1. High-bush forms, generally over 4 feet: found principally in marshes 2

1. Low-bush forms, generally less than 3 feet; found on dry sandy soils 3

2. Leaves somewhat downy beneath; berries bluish-black, with much bloom ----Common high-bush blueberry (V.Corymbosum).

2. Leaves quite downy beneath; berries deep glossy black, without bloom ....Black high-brush blueberry (V. atrococcum).

3. Flowers with anthers exserted; berries green to faint purple, not edible .... Deerberry (V. stamineum)

3. Anthers not exserted; berries blue, with a bloom, sweet and edible 4

4. Low bush, 6 inches to 1½ feet, often procumbent; leaves green below, finely toothed, narrow and usually elliptical ... Early low blueberry (V. pennsylvanicum).

4. A stiff shrub, usually 1 to 2 feet, seldom procumbent; leaves glaucous below, entire or sparingly toothed, oval to obovate ..... Late low blueberry (V. vacillans).

The common high-bush blueberry, as well as the black high-bush species which some authorities class as a variety of the former, sometimes attain to small tree size, particularly in the southern Appalachians. They grow in swamps and moist woods, often in sphagnum bogs, in association with winterberry, button-bush, black alder, or possibly tamarack and black ash. In autumn the leaves turn to a brilliant scarlet and remain so for a long time. Their berries are among the last to appear on the market and are of such large size and fine flavor that numerous attempts have been made to cultivate them in various states, notably Maine, New Jersey and Michigan and possibly elsewhere.

Chas. C. Deam, in his "Shrubs of Indiana", makes the following remarks: "This is the species which furnishes the most of the blueberries of our market. The high-bush blueberry marshes without cultivation are more profitable than adjoining farm land. Yet by draining our lakes, many of our largest blueberry marshes have been destroyed. As yet

blueberry farming has not been undertaken in Indiana. With the greatly improved varieties it has proven quite profitable in the pine barrens of New Jersey, and it is quite probable that some of the moist and thin sandy soil of some of our northern counties could be used for this purpose."

The deerberry, or squawberry as it is sometimes called, is our only species which doesn't yield edible fruit. It is a much rounded and bushy plant, having an abundance of showy white flowers, with prominent yellow anthers protruding beyond the corolla lobes, borne in spreading racemes. It frequents poor and dry soils and very often associates with sweet fern.

Undoubtedly most of the blueberries sold in all eastern markets are those of the early low variety. It is the lowest and earliest species, with ripe fruit about the middle of June. Its large, light colored berries, are indeed sweet and fine flavored, and often hand in ropes on the low bushes and weight them to the ground. This blueberry prefers rocky areas and will be found high up on the slopes of our mountains. The fruit of no other, unless it be the high-bush variety, excels it in excellence and popularity.

Somewhat later, in July and August, comes the ripened fruit of the late low blueberry. Though its berries average rather small and not so juicy, few others are more intensely sweet. It may be known by its bright green stems,

also by the somewhat rounded, light green leaves which exhibit extreme variations in size. Its flowers, leaves and fruit appear to be concentrated toward the extremities of the branches, so that a large part of the plant seems bare and leafless. Then too, it has the peculiar and distinctive habit of often having few or no leaves on its fruiting stems which may be bare from the ground up; several other sprout shoots in each clump carry the foliage and assimilate food - a manner of growth that reminds one of some of the ferns.

Lesson 8. (c) Natural Reforestation.

All young trees are "natural" in a way. But when the seed is collected by human effort and the seedlings and transplants are grown in nurseries and then set out on land to be reforested, we call it "artificial reforestation." This phase includes a large field and will be taken up in the next period.

But by far the largest part of reforestation is accomplished at a less expense than by planting. Nature will reproduce forest trees on an area indefinitely if man does not destroy her efforts by ax and fire. In fact, by proper removal of mature timber, the "natural" seeding of the species desired may be accelerated, though foresters sometimes fidget at the time taken by nature to re-establish a forest stand. Natural reforestation of our complex forests is not yet completely understood by American foresters. It is one of the many lines of investigation of our forest research organizations; but in its different ramifications it will take many years for its reduction to definite rules of procedure.

Trees reproduce:

(a) Some species, chiefly broad-leaf, by stump sprouts.

(b) All species by seed.

(c) A few species artificially by rooting cuttings.

Natural reforestation is continually in progress by both seeding and sprouting. Much of the young hardwood stand in the central and southern part of the State - oak, hickory, chestnut type, is made up of sprout growth, with a light admixture of seedling trees. Many stands are exclusively sprouts, due to fires killing off all previous growth, and leaving no possibility of early seed production. For trees that sprout well, sprout (or "coppice") reproduction is the quickest and easiest to secure. It grows the fastest up to ploe sizes and for products requiring small diameter trees is recommended. Thus for fuel wood, posts, mine props and ties, R.R, ties, small poles and piling. For large sized trees of greater age sprout timber generally fails, due to the entrance of butt rots (fungous disease) from the old decaying stumps. The vitality of some species fails after several generations of sprout timber, so that foresters generally recommend the securing of a certain percentage of seedling trees in the young stock after each cutting. This keeps replacing failing stump sprouts with stumps of greater sprouting vigor. Another reason for not leaving sprout timber grow to too large size is the fact that stumps often diminish in sprouting capacity beyond a certain size.

This natural sprouting ability of hardwoods and its complete absence in Pennsylvania conifers (except for small

sized pitch pine) accounts largely for the conversion of our original white pine and hemlock forests into hardwoods. The few cull hemlock and pine trees left by the lumberman were quickly killed by fires, leaving only hardwoods to come up from sprouts, or aspen to have seed blown in from unburned areas, or fire cherry seeds carried in by birds.

Sprout hardwood forests are usually cut clean, yielding large quantities of relatively low grade wood products. These products will not stand high transportation costs. Therefore sprout forests are particularly suited to privately owned forest lands near centers of population, near mines, or connected with agriculture for their local markets. Formerly they were the large producers of charcoal for iron smelting.

Chestnut was one of the best of our eastern sprout forest species. This is now practically wiped out by the "blight" (bark fungous disease). The oaks are generally good sprouters, hickory is fair when young. Yellow poplar will sprout but mostly reproduces from seed. Yellow birch sprouts, and beech root-suckers. It seems odd that the heavy seeded species, in which wild animals, rodents and insects do much damage to the seed are among the better sprouters, chestnut, oaks, hickory, beech, illustrate this. Walnut is an exception - it does not sprout well. Basswood or

linden on the other hand does sprout rather well. Sugar maple will sprout but reproduces better from seed. Red maple sprouts well.

Natural hardwood seed reforestation is harder to secure than sprouts, because of the following reasons:

(a) Many trees do not bear seed crops every year.

(b) Many kinds of tree seeds are eaten by wild animals, deer, bear, squirrels, birds, mice, etc.

(c) Trees from seed are rather small and shallow rooted the first year or two so that drought kills off many more small seedlings than sprouts.

(d) If the ground is covered deeply with unrooted leaves or pine needles, the seed root may not be able to penetrate to mineral soil.

A few light winged and seeded species like aspen, which seeds prolifically, may appear on heavy burns more plentifully than sprout hardwoods,

With a generally heavy oak forest seed year in 1932, and moist summers in 1932 and 1933 following, seedling growth at the present moment is extra good in the oak stands of central and southern Pennsylvania.

The forester must exercise much more skill in regenerating his stands with seedling trees of the more desirable species after cutting. He frequently must make an

advance cutting of the less desirable species and of others when too dense, in order to let in more sunlight, which stimulates seed production. A second cutting is then made after the seed is ripe so that the logging will stir up the soil for a better seed bed. For some species it is desirable to leave a further scattered stand to shade the young seedlings for a few years and protect them from drought, as well as to add more seed in later seed year in case the one seedling is insufficient. When there are enough seedlings established the last of the old timber may be removed. The above cutting methods result in an almost "even-aged" tree stand.

If a fire runs through hardwoods while the trees are in the sapling or pole stage and before seed bearing age, the stand may be automatically reduced to a sprout forest from the fire killed tree stumps. When undesirable trees are too plentiful in the sapling reproduction, an early thinning may reduce them and give the desirable trees the needed advantage.

Practically all conifers in Pennsylvania and the United States must be reforested by natural seeding, or when seed trees are all destroyed by artificial planting of nursery grown seedlings. There are two exceptions in southern cypress and California redwood. The latter is a particularly prolific sprouter and good sized saw timber can be grown from its

sprouts.

A great advantage of natural seeding over planting lies in the smaller cost and the ability to secure a larger number of seedlings per acre. Planting costs become prohibitive in America when spacing is reduced much below 6 x 6 ft. or roughly 1,200 trees per acre. 4 x 4 spacing requires 2 1/4 times the trees and cost as 6 x 6.

On the other hand where trees are desired widely spaced as in turpentine forests, planting up bare land with 2 or 3 hundred trees evenly spaced may be cheaper than thinning very dense thickets of naturally seeded saplings.

When fire risks are great and seed trees are present, naturally seeded areas entail less financial loss when burned and may often be re-established at less cost than by planting.

Other methods of cutting mature timber to secure natural reproduction are by the "single tree selection method", where single large trees are removed and the opening seeded in. This is particularly applies in spruce and fir and other shade enduring species. For light demanding species like the oaks it has not been demonstrated as yet, and would appear of doubtful application.

For species requiring more light for the seedling stage the "group selection" system is used in which groups of

mature trees are removed at once making larger openings to be seeded in.

For even aged clear cutting besides the previously mentioned method of removing the mature stand in three cuts, separated by a small number of years, another method is to cut clear at once cutting in narrow strips and secure seeding from seed bearing trees in the stand on the side of the strip. The width of the strip depends on the natural carrying distance of the seeds, and the need of sheltering the seedlings. Other cutting methods are used but these indicate the natural reforestation or "regeneration" or "reproduction" as practiced by foresters.

Nature provides help for sowing tree seeds. Many seeds have wings so that the seeds glide in the breeze quite a distance from the trees. Pine, hemlock, spruce, maple, birch, ash, elm, and basswood are examples. Some seeds are so light and their wing so cottony (poplars and "cotton" wood) that their seeds carry for miles in the wind. Other seeds have hard shells with a fleshy covering and are carried by birds and dropped. Cherry, black gum, red cedar are examples. Other seeds have large kernels and are stored in the ground by squirrels, mice, or gophers, which fail to relocate them and they germinate. Such include walnuts, hickory nuts, beech nuts and often coniferous seeds as well. There are many other special methods of tree seed dissemination.

(d) Questions: How are seeds of the important local tree species distributed in the main? What bearing has methods of seed dissemination had on the kind and location of the various tree species that make up the second growth forests of the locality?

(e) Field Trip. Take students to sites or points where they can see the answers to the above questions. Point out what trees sprout vigorously, and which ones are weak or fail in this respect. If there are old fields near with natural reproduction coming in, visit one or more of these and list the species found. Compare them with those found on nearby forest land and then try to account for differences. Also note whether the kinds of trees that come in naturally on old fields are of themost desirable sort or not. Is the new stand dense and even enough to cause the trees to grow tall, straight and upright?

Lesson 9. (a) Forestry in Europe and Canada.

Many american forest lovers as well as professional foresters find visits to the forests of Europe extremely interesting and instructive. In some of the older European couhtries the forests were abused much as they are here. The local scarcity of fuel and lumber and the interest in game led to the early development of methods of reforesting their cut-over and waste lands in Central Europe. The increased and continued productivity of these forester managed forests in Germany, Switzerland and France, led Sweden and Finland relatively recently to undertake a national forest policy directed to cutting no more than the annual growth in their forests. In fact the cut is less than the growth where a building up of the forest stand is necessary. This is the essence of forestry - measure the annual forest growth and cut less than this growth to build up a depleted forest. Only in over-mature forests should the cut exceed the growth and then only until the proper balance of merchantable timber and young growth is reached. After this the cut and growth should balance.

GREAT BRITAIN

Great Britain possessed before the war only about 3 million acres of woods. These were largely deer and game forests of large landed estates and produced only 47

million cubic feet of wood, or 15 cubic feet to the acre, each year. In the face of this small production Great Britain imported 638 million cu. ft. of round and sawed timber and pulpwood. In other words Great Britain has to import about 93 percent of her wood needs. This was rather easily done for Great Britain is a maritime and manufacturing nation. Normally it has been able to trade manufactures to Sweden, Finland and Russia for timber and haul the imports in British ships. But when the great war broke out Britain was barred out of the Baltic Sea and cut off from her foreign wood supply. Further, the German submarine offensive so reduced British shipping that vessels could not be spared to haul timber from Canada or the U.S. Yet mine props for the British coal mines and other timber was an absolute life necessity. For the powerful British navy would be helpless without coal, and British coal had to be furnished to Italy and France. In order to keep going during the war Britain slashed off about 300,000 acres of its own forest for the needed timber supply, and France cut heavily into her reserves to help out. After the war Britain promptly moved to correct the repetition of this danger and planned reforestation on a larger scale. Not only were the 300,000 acres of war cut woods to be replaced, but large areas of additional more or less idle land was to be bought and reforested - estimated as 1,870,000 acres.

IRREGULAR PAGINATION

This move was also intended to help unemployment as the work of one man was estimated to establish and care for 75 to 100 acres. After 10 years of planting, brushing plantations, draining and road building, thinning work would commence. At 40 years the wood cut should begin to pay expenses and at 80 years the planted forest is expected to be in full production. With such intensive forestry practice the average Pennsylvania state forest of around 50,000 acres would require the constant labor of 500 men.

FRANCE

The skeptical will ask, "What assurrance has Britain that such a large program of reforestation will succeed financially"? France possesses the answer to this question. Along about 1780 France had a large expanse of drifting sand, swamp and malarial land in the Gironde and Landes areas. Bremontier persuaded the French Government to undertake draining the swamps and fixing the drifting sand dunes temporarily by brush fences and beach grass and shrubs, and then planting maritime pine over all to make the work permanent. The French* State, communes and private owners reforested, under government leadership, over 1,600,000 acres of this worthless sand land costing less than a dollar an acre, at a cost of $10.75 per acre for the more costly

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* See Studies in French Forestry - Woolsey - 1920.

dune fixing and planting work, and $4.25 for planting the lands behind the dunes. The total cost including roads was less than 10 and one half million dollars. By the beginning of the war these afforested lands were bringing in a revenue of $2,700,000. These afforested lands costing less than one dollar per acre are now valued at over $54.00 per acre, and in places as much as $93.00 per acre. This is notably successful forest building on a large scale. These French maritime pine forests are our competitors in producing turpentine and rosin.

The French are now working on a large mountain reforestation program to control floods rushing down from their mountains and causing damage in the lower lands, and cities on the river banks. The French need no additional proof of the financial value of forest establishment. Have they not created thriving and properous provinces that now help support the government, out of malarial barren regions that formerly required continual government aid?

Though the French largely use conifers in the sand dune forests and mountain planting, most of the French woodlands in the agricultural areas are hardwood (77%), of which oak and beech occupy 46%. In these hardwood forests fuel wood is an important product, and fuel wood forests are largely sprout (coppice) hardwoods. They form one fourth of the 24 million acres (pre-war) of French forests.

Much of the French forests are in the hands of the small farmers and are low in production.

The average production seems to be something over 40 cu. ft. per acre and year. The French have had national forest control to some degree since 1669 with some breaks.

GERMANY

Germany has about 31 million acres of forest (post war) or about 2½ times the forest of Pennsylvania. Unlike France three fourths of Germany's forest is conifer - since Germany has a cooler climate than France. The governments (largely state or city) own about half of the forest and some states regulate cutting in private forests quite strictly and require reforesting cut-over land. The German forests are exceeded in productivity only by certain of the Swiss forests. They grow about 56 cu. ft. of wood per acre and year, though some single forests produce over 100 cu. ft. The Germans were the world leading foresters though they are now hard pressed by the Swiss, Swedes and Finns. The Germans early advocated the clear cut and plant or even-aged forest stands, but the Swiss are leading them into the better uevenaged stands with natural seeding.

SWITZERLAND

Switzerland has such a rugged land surface that the government (principally the cantons) owns even a larger part of the forest (over 70%) than does the German government. Switzerland also has a much stricter government regulation of private forests. It has one of the best equipped forest schools in Europe.

The city forest of Zurich is worthy of special mention. It is located on rugged hill-sides unfit for agriculture. It exceeds 4,000 acres in area and serves as forest and park. Yet it nets over $25,000 ($6.00 per acre) above expenses from the timber and wood sold. This forest demonstrates that forests can serve both for timber production and park purposes. It is criss-crossed with drives and foot-paths. It contains beautiful streams, vistas and places for the city dweller to picnic in.

While Britain, France, Germany and Switzerland must import some timber, Sweden, Finland and Russia still are able to export a surplus. Sweden and Finland have just completed a survey and inventory of their forest stand and growth, and they are regulating the cutting to make the forest a productive perpetual resource of the first importance. This is vital to both Sweden and Finland as half or more of their total export is timber, wood, wood pulp and paper (made from wood pulp).

Russia and Siberia are reputed to have large reserves of virgin timber, but recent writers claim the accessible areas are over-rated.

Although Britain neglected her own home forests until the war taught her a lesson, she early began a wise forest policy in India. In some parts of India all forest growth was stripped centuries ago. The people burned dried cow manure for fuel and robbed their farm land of this much needed fertilizer. The British rulers early began extensive forest plantings to relieve this situation, and adopted controlling measures for natural forest areas not yet stripped. The teak forests of India have been particularly well cared for, so that India is well on her way to bettering the welfare of her teeming millions by giving them a home fuel and timber supply, with teak and other tropical woods for profitable export.

South Europe has long been held up as exemplifying the disastrous results of centuries of deforestation, and rightly so. Mountain slopes formerly timbered are bare, fuel is scarce, over grazing was practiced in a desperate effort by the peasants to make a living; homes were often stone hovels; mountain ravines were dry or rushing torrents. Today the first American report on the "Bonifica Integrale" or "Italian National Plan of Land Utilization" has been received. The Italian government has undertaken to remedy

the progressive destruction of the mountain soils, and the hard living conditions of the mountain peasant through extended reforestation and control of the mountain torrents. It is draining the swamps, and afforesting the drifting sands. It is building reservoirs and water-powers and even homes. The Italian government is spending 500 million dollars over a period of 14 years on this work, and cooperates with associations of local land owners.

This Italian land conservation plan is even more complete than our Emergency Conservation work, and affords a model for our Tennessee River Valley Improvement project.

CANADA

Canada still has timber for export though her reserves would not last the United States over 10 years if we had to get all our timber from her.

In this entire discussion one fact looms up clearly. The United States must raise its own wood and timber if it wishes a cheap and abundant supply. The only exporting nations of Europe-Sweden, Finland and Russia - have customers in Europe and markets near at hand, except for partly manufactured material like wood pulp. Tropical South America has jungles of wood, most of which is poor grade tropical hardwood not fitted for building or industrial use, and also very expensive

to get out. The suggestion of evading our reforestation problem by tropical wood import is bound to fail. We have the land, we have the trees, we have the workers in need of work. Increased reforestation is the solution of our timber problem, and water, game, and recreation problems at the same time.

Italy is showing the way to the related development of reforestation, erosion control, water and power development, swamp drainage, land reclamation and home building. Reforestation is only a part of coordinated land and water use.

(b) Tree and Shrub Identification.

Broadleaf simple alternate leaved trees: mulberry, osage orange, hop hornbeam, blue beech; shrubs - flowering raspberry, wild hydrangea, rhododendron, laurels.

RED MULBERRY (Morus rubra)

So frequently does one see red mulberry planted in dooryards or growing about the margins of fields that it has come to be looked upon as more of a cultivated species than a forest tree. Sometimes it does occur in rich open woods, such as in valleys, on foothills, or the banks of streams, but is nowhere abundant. Its distribution may be considered local and sparse over eastern United States, though it covers a broad territory from Massachusetts to Florida and west to the Dakotas and Texas. The largest trees are found in the lower Ohio valley and the southern foothills of the Appalachian mountains.

Generally it is a small to medium sized tree, and with a short, more or less crooked trunk. Often the trunk divides into several stout spreading limbs, each of which bears so many interlacing twigs as to form a dense rounded crown. Its branches twist and turn at sharp angles, giving to the tree in winter a picturesque appearance, quite like that of sassafras. The trunk and limbs are covered with a yellowish brown bark, divided into narrow, flat ridges which

occasionally loosen and curl upward at the ends. Both inner bark and roots have tough, fibrous qualities; the Choctaw Indians of the Gulf States wove these fibres into a coarse cloth.

The leaves of red mulberry are unusual and easily recognized. They are of alternate arrangement along the twigs and various forms of leaf may be found on one tree or even the same branch. The leaf-form most frequently seen is ovate or rounded in outline, abruptly taper-pointed, and with coarsely toothed but unlobed margins. Other leaves show from 2 to 3 or more round-notched, abruptly-pointed lobes, which too suggest somewhat those of sassafras. They vary from 4 to 6 inches long, are prominently 3-nerved at the base, and with veins sunken on their rough upper surfaces, If one crushed the short stout petioles, or even the twigs, they emit a milky juice, as is also a characteristic feature of Norway maple. Its foliage turns yellow in autumn before falling.

During May, when the leaves are only partially developed, appear the small greenish catkins. Staminate and pistillate flowers occur either on separate trees or on different branches of the same tree. The staminate, in narrow spikes about two inches long, droop from the axils of the leaves. But the pistillate spikes are short and dense and develop into a compact and adhering cluster of tiny drupes,

hanging on a slender stalk. In size, shape and color, these aggregate fruits, about an inch long, closely resemble a blackberry. Unlike the latter, however, each tiny round drupe of the mulberry is tipped with a persistent style, which gives to the fruit a somewhat fuzzy appearance. When full grown it is red, but turns black or very dark purple when ripe, in June or July. Finally the berries become soft, many-seeded, and intensely sweet and succulent. Very seldom do they mature uniformly, but instead berries of all degrees of ripeness occur together on every branch, which greatly lengthens the period of their usefulness to birds and animals that feed upon them. Quite often the trees are planted to provide food for swine and poultry or to attract song birds. Most country boys and girls know and enjoy mulberries, but so also do the birds, hence the resulting competition is keen.

It is easy in winter to identify red mulberry by means of its twigs, buds and leaf scars. The twigs are slender, though rather stouter than those of most exotic mulberries that have been introduced into this country. They appear smooth, somewhat zigzag, and of a reddish to greenish-brown shade of color. Some too claim that when chewed they have a rather sweetish taste. But the buds and leaf scars offer equally helpful assistance. Its stout, pointed, ovate buds, with dark-margined scales, should not be confused with those of any other tree. Then, too, the terminal bud is absent and the lateral ones diverge

noticeably from the twigs. Beneath each bud stands a concave, bowl-shaped leaf scar which, together with other twig and bud features give to this tree many prominent ear-marks of identification when the leaves are off.

The wood of red mulberry is very durable in contact with the soil and has been a favorite for fence posts since pioneer times. Farmers of the prairie states still plant it for that purpose. Its rich brown heartwood polishes well and quite resembles black walnut, though usually of a little lighter shade. If the tree were more abundant and not so widely scattered it would undoubtedly assume a prominent place in furniture and interior finish.

The white mulberry (Morus alba), so called from its nearly white fruit, is the one mainly employed in sericulture. No satisfactory substitute has ever been found for its leaves as food for silkworms. Costly experiments in early colonial days proved conclusively that our native red mulberry could not be so utilized. White mulberry is a native of China and has been cultivated from the earliest times in Asia. Since about the 12th century it has been successfully grown in Europe, especially in the Mediterranean region. It bears leaves that are smaller and noticeably smoother than those of red mulberry; also its twigs are finer and yellow in color. Weeping forms of white mulberry may be seen growing as ornamental trees on lawns

and in parks in this country.

Another species, known as paper mulberry (Broussonetia papyrifera) belongs to a closely allied genus and is sometimes seen growing in America. It is a native of Burma, China and Polynesia, and widely cultivated in Japan, where the bark is used for paper-making. It varies from a shrub to small tree size, with large lobed or entire hairy leaves, carried on long petioles, and occurring in either alternate or opposite arrangement on its rough scurfy twigs.

OSAGE ORANGE (Maclura pomifera).

In the days when wire fences were unknown in this country it became popular practice to plant hedges of Osage orange. Its very thorny twigs and branches, when given proper attention from the time of planting, quickly develop a growth of such defensive nature as to defy passage by man or beast. The fad became widespread, particularly in the prairie regions of the Mississippi basin, although root and branch cuttings of Osage orange were introduced into perhaps every state of the Union. For a time it appeared as if this tree offered an easy, adequate and final solution to the fencing problem. Then came the advent of wire fences. Also an increasing population demanded more intensive land utilization. Spreading hedges were found to monopolize too much valuable ground. So in time they, along with stump, stone and worm fences, gradually gave

way to more modern materials, particularly on the best and most fertile soils. But many of these old hedges still exist throughout the country and, to a more limited extent, the tree is still being planted for that purpose where conditions are found to be suitable. Once established, however, it becomes difficult to eradicate as its long roots are voracious feeders and produce suckers quite freely.

Originally the tree existed in only a very limited area in what was then known as the old Indian Territory. It inhabited rich bottomlands throughout southern Oklahoma, Arkansas and northern Texas, reaching its largest size on the black prairie soils along the Red, Boggy and Blue rivers in Oklahoma. Later, its popularity as a hedge plant caused Osage orange to become one of the most widely distributed of American forest trees, but entirely by artificial means. A close relative of the mulberries, it is the sole representative of the genus Maclura to be found anywhere in the world.

Osage orange is a small to medium-sized thorny tree, usually with a short stout trunk and spreading branches, forming a rather open and irregular crown. Often its trunk is clothed with a dense growth of sprouts. The bark covering of trunk and branches is dark orange-colored and becomes deeply furrowed and shreddy on old trees. If one cuts the live bark on any part of the tree it exudes a thick, acrid, milky juice. Its rather fine twigs are smooth, light green, and noticeably zigzag; also they contain a yellow pith. Near each bud or

leaf-scar and in the axils of the leaves will be noticed a single stiff, straight, and extremely sharp thorn, about an inch long. Occasionally, however, a form with spineless branches may be found, but instead of spines it will then invariably show spur-like lateral branchlets. Near each spine occur one or more rounded knobby buds, partly immersed in the bark. These small and inconspicuous buds of Osage orange much resemble those of hawthorn and honey locust.

Its name Osage orange refers to the tribe of Osage Indians who formerly inhabited the southwestern region to which this tree was native. They are said to have made bows and war clubs of its tough and elastic wood, which use gave rise in that locality to the name bow-wood. Other names for this tree include yellow-wood, mock orange, hedge apple and hedge tree.

The terms orange and apple are meant to be descriptive of its odd fruit, which in size and shape resembles a green orange or a grape fruit, but is more warty or tuberculate in appearance. It is a compound, fleshy fruit, heavy and solid, but inedible. If bruised it gives forth a milky juice which quickly turns black. Ripening in autumn, they soon fall to the ground, and may be found under the tree all winter.

The foliage of Osage orange is a deep lustrous green. Its alternate leaves, with their ovate shape, tapering

tips, and entire margins, suggest those of the cultivated pear. They vary from 2 to 4 inches in length and are borne on slender petioles. It is claimed that in Europe these leaves are sometimes used as food for the silkworm. Like other parts of the tree, the leaf petioles if broken exude a thick white juice. Its foliage changes to a clear yellow in autumn.

Like many other representatives of the Mulberry Family (Moraceae), to which Osage orange belongs, it bears its staminate and pistillate flowers on separate trees. Botanists use the term "dioecious" to describe such plants, whereas they call others "monoecious" which bear both kinds on the same individual. But the clusters of small greenish flowers on this tree are so inconspicuous that few people ever notice them. They unfold in June and are hidden in the axils of the leaves which are then almost fully expanded. When fertilized with the pollen from nearvy staminate trees, the pistillate heads slowly develop into the curious orange-like fruits that appear so conspicuous.

The wood is heavy, very hard and strong, and with sapwood scarcely half an inch thick. Both its structure and appearance so closely resemble the heartwood of black locust as to make it difficult to differentiate the two woods. From its rich, yellow wood, sometimes streaked with red, is derived a yellow dye material that accounts for the occasional name of yellow-wood. Its long yellow roots too contain this valuable dyestuff. The Osage Indians and other western tribes dyed their

blankets with bark taken from the roots of this tree. This dye, claimed to be more permanent than the aniline, has also been utilized by textile manufacturers to give a pure yellow tint to wool. The bark is sometimes used for tanning purposes.

Few, if any, other post timbers prove more durable in contact with the soil than do those of Osage orange. Other uses for this unusually strong hard wood include police clubs, wagon felloes and rims, bridge piling, rollers, insulator pins, rustic chairs, tobacco pipes, and also to a limited extent for parquetry floors and paving blocks. Quite often the tree is planted as an ornamental for its handsome bright green foliage and curious fruits which are certain to attract attention. The fact that it isn't fastidious as to soil requirements adds to its popularity as a hedge and ornamental tree.

HOP HORNBEAM (Ostrya virginiana).

This is invariably a small scattered tree of the forest undergrowth. Thriving under the shade and protection of larger trees, it grows tall and slender and with only a narrow wisp of a crown. Given more room to expand, it develops a bushy growth of slender branches and fine interlacing twigs. Quite birch-like in most features, the hop hornbeam is another frequent associate of beech and sugar maple andseems to prefer dry or well-drained, rather open woods. Only rarely does it become more than 40 feet tall and about a foot in diameter. To

find larger specimens one must visit the southern Appalachians or the Southwest, where its best development is attained. Throughout most of its range, from Cape Breton to Minnesota and south to Florida and Texas, it is usually a small tree. Since it grows neither large nor fast, some regard it as a weed species in the woodland - one to be removed so as to give place to others more valuable. It does, however, produce a useful wood for some special purposes and few native trees have more interesting habits or features.

Hop hornbeam has a thin and grayish bark, very scaly, and on older trees somewhat fibrous and shreddy. It becomes finely furrowed and peels off in short narrow strips, often loose and curling at both ends, after the fashion of the silver maple, though its flakes are much smaller and thinner. Another distinctive feature of this tree is its fine twig sprays - miniature replicas of those of beech - presenting in mass form a zigzag pattern. But though seemingly delicate, these slender branchlets will be found to be quite tough if one attempts to break them. They appear smooth and reddish brown, with pale scattered lenticels. In winter many twigs have, at their tips, young staminate catkins, usually in 3's, stiff, cylindrical, and each about a half-inch long. The buds are smooth, pointed, strongly divergent, and usually have 8 visible, longitudinally-striated scales. Their bud scales, sealed down with a gummy wax, invariably appear mottled dull green and brown or show flecks of green in their color scheme. While these buds super-

ficially resemble those of black birch, the fact that they are blunt pointed and the terminal one is absent on hop hornbeam makes it easy to distinguish between them.

It would be hard to find leaves of a finer and more delicate texture than those of the hop hornbeam. Their shape is ovate, with tapering tip and rounded base, and margins doubly, yet finely serrate. They are thin and translucent, but surprisingly tough nevertheless, and with a delicate tracery of veins impressed on their smooth upper surfaces. These dull, yellowish-green leaves appear more or less plaited along their straight primary ribs, which also tend to fork near the leaf margins. They are joined to the twig with a short petiole, hardly a fourth of an inch in length. Autumn's first light frost transforms them into a mass of golden yellow. Others which bear leaves most nearly like those of this tree include black birch and blue beech, both members of the birch family (Betulaceae) to which also hop hornbeam belongs.

Before the leaves have fully expanded the staminated aments, which have remained on the branches all winter, lengthen into pendulous catkins. Wind and bees transfer their greenish-yellow pollen to the pistillate flowers which terminate the newly-developed leafy shoots of the season. Hop hornbeam blooms in April and May and by August or September its fruit has ripened. And what a queer fruit it is too, resembling nothing quite so much as the papery clusters of "hops" borne on the cultivated hop vine, which latter is so

essential to the brewing business. This hop-like fruit consists of about a dozen small inflated sacs, each membraneous sac enclosing a hard nutlet and all of them loosely arranged about a central stem, the entire cluster being usually about two inches long and possibly an inch wide. These light green strobiles show a pretty contrast against the darker mass of foliage. They generally cling on the tree until late autumn, the little sacs falling then one by one and leaving behind the persistent stalk to which they were attached.

For hundreds of years the wood of this tree has been recognized and valued for its exceptional qualities. When the Indians yet roved this country they somehow became acquainted with the unusual strength and elasticity of hop hornbeam, and it is said that they chose it for the handles of their stone war clubs. Even when virgin timber was everywhere plentiful, the early white settlers considered this the best material obtainable for making wedges, tool handles, levers, skids, and wagon tongues. For such uses they preferred it to the best of oak, hickory or elm that was to be had. Their name for it was hornbeam because it seemed as tough and hard as horn; or they compared it to the hardest material they know, and hence called it ironwood. Indeed, it is claimed to be 30 per cent stronger than white oak, and also 46 percent more elastic than this undisputed king of American hardwoods. Its slow growth causes the wood to be close-grained, hard and heavy. Then too, its transition from white sap to brown heartwood becomes an extreme-

ly slow process, the change necessitating sometimes as much as 50 years or more.

Hop hornbeam is a tree that is too small and scattered ever to be of much commercial importance. But wherever it occurs it has been, and still is, employed for many specialized local and domestic needs. Besides those already mentioned, some additional articles which are sometimes made of this wood include fence posts, wheel cogs, mallets, axles and felloes for heavy wagons, rungs for ladders, teeth for wooden rakes, and particularly for the beams of ox yokes. All these uses require strength, stiffness and durability, qualities which hop hornbeam possesses. For many such purposes this tree and dogwood might be considered as strong competitors. This tree is not advised for forestry purposes because of its slow growth, small size attainable, and rather limited field of usefulness. But as an ornamental it is attractive on account of its gracefulness, delicate foliage, loose scaly bark, and odd fruit clusters.

BLUE BEECH OR AMERICAN HORNBEAM (Carpinus Caroliniana)

A close relative of hop hornbeam is the blue beech, a small spreading tree of moist woods and stream banks. Unfortunately, both are often indiscriminately called ironwood or hornbeam, the unqualified use of which names tends only to confuse the two trees. And this frequently happens, despite the fact that to either species belong many distinctive

characteristics that stamp each with a marked individuality. Their ranges coincide almost exactly, excepting that blue beech reappears on the mountains of southern Mexico and Central America. Likewise, both seem to be most abundant and of largest size on the western slopes of the southern Alleghany Mountains, and also in the Southwest, in Arkansas and Texas. Often this tree is called water beech, an appropriate name, because it is usually seen growing along the margins of swamps or slow-moving streams, where it and black alder become boon companions.

If one is at all observing, there seems but slight possibility of mistaking blue beech for hop hornbeam or in fact for any other tree. It has a trunk and bark that mark it indelibly. Being always thin, smooth and of a grayish cast, its bark has been likened to that of beech. But young beech saplings are not to be confused with this entirely unrelated, almost shrub-like tree. Its bark is of a darker shade than the pure gray of beech, and seems more slate-colored or a blotched bluish-gray, hence the common name blue beech. The trunk may be easily recognized because, in addition to being short, crooked, twisted, and covered with limbs, it is nearly always vertically corrugated. Projecting rounded ridges run up and down along the trunk and larger branches and stand out prominently, somewhat like the protruding muscles and sinews on the limbs of an athlete. So ribbed and fluted is the bole of

blue beech as to appear, in cross section, almost any shape except round. Naturally the sawmill operator would'nt be interested in this tree, even if it did attain to some size, for its board foot yield would at best be slight. It seldom goes to sawmills, however, but in the rough finds many local uses similar to those enumerated for hop hornbeam. The wood is close grained, durable, very hard, stiff and strong.

Although it is upon the appearance of the bark more than upon any other character that the woodsman depends in his recognition of trees, a knowledge of twig and bud features often proves invaluable when leaves or fruit are not present. And so it is with blue beech, young specimens of which, without fluted bark,may prove puzzling unless one is familiar with other, possibly less conspicuous, characteristics. It should be noted that the tree bears remarkably fine twig sprays and that they tend to be arranged in flat spreading layers. It is their habit to zigzag and interlace so intricately as to form a maze of bramchlets. Also many of the lateral ones remain so very short that their appearance is almost spur-like. Though silky at first, the twigs become at maturity smooth, dark red and shining, and with a few pale scattered lenticels. Arranged alternately along their sides and pressed close to them will be noticed many small, pointed, reddish brown buds which show a tendency to be four-angled. Each bud has from 8 to 12 visible four-ranked scales with pale margins, striated surfaces, and increasing in size toward the apex. Unlike hop hornbeam, no

naked staminate catkins terminate the dormant twigs of blue beech; instead, its male flowers, which develop in the fall, remain over winter in the form of buds, quite like the leaf buds only larger. It might be mentioned too that this tree bears no terminal buds. Nor do its buds ever show any green coloring as it typical of those of the hop hornbeam.

If one were given a single leaf of blue beech and asked to identify it, the task might prove difficult for the leaves of some other trees, such as the black and yellow birch and particularly hop hornbeam, resemble it rather closely. Nevertheless, it is entirely possible to distinguish between them. Blue beech leaves have in common with the above-mentioned species, an ovate shape, as well as rounded base, tapering tip, and margins that are sharply and doubly serrate. They also are carried on slender petioles and the leaf blade averages from 2 to 3 inches long. At maturity no pubescence is evident, except possibly in the axils of the veins beneath, which fact alone should readily distinguish them from yellow birch. But neither of the two mentioned birches exhibit such thin and delicate leaves as are those of the blue beech, nor do they have the veins quite so prominently sunken on their upper surfaces. Even the foliage of hop hornbeam seems slightly thicker in texture; also with a lighter shade of color, somewhat of a yellow-green rather than the deep blue-green of its near relative. Some authorities separate these two latter genera on the basis of their leaf venation, claiming that

Ostrya shows veins which fork near the leaf margins whereas those of Carpinus are invariably straight and end in the primary teeth. But in autumn their individuality becomes quite evident, for then the foliage of the hop hornbeam is transformed to a clear yellow, that of the blue beech an orange-yellow to scarlet.

In early spring, just as its leaves are starting to unfold, the blue beech puts out tassels of staminate flowers like its cousins the alder, the birch, and the hop hornbeam. Their purpose is to pollenate the short female catkins terminating the leafy shoots, and soon after that is accomplished they wither and drop. By August or September appear the ripened fruits, looking like small clusters of distorted or malformed leaves. But closer examination reveals about a dozen or more tiny, ribbed, seed-like nutlets, each fastened to the base of a three-lobed, halberd-shaped bract, and all so arranged about a central stem as to form drooping clusters, about two inches long, and somewhat more than an inch in width. These bracts, which serve as parachutes for the nutlets in their wind dispersal, are prominently veined, to all appearances leaf-like, and are usually serrated on but one margin of their larger or middle lobe. Not infrequently this little tree appears heavily loaded with fruit clusters, and their light shades of green contrast noticeably with the darker foliage, while many of them still cling to the branches till long after the leaves have fallen

GREAT LAUREL OR RHODODENDRON (Rhododendron maximum)

This most beautiful of our native shrubs, whose praises have been sung by nearly every nature-lover so fortunate as to have seen it blooming in its woodland haunts, inhabits moist shady nooks and ravines, particular along mountain brooks. Where conditions are most to its liking it forms extensive, almost impenetrable thickets much frequented by deer for protective cover but so deep and tangled as to be locally called "hells". From the British Possessions to the north of us it follows southward along a narrow belt, practically within the confines of the Alleghany mountain ranges, and becomes most abundant from Pennsylvania to Georgia. Of the twenty or more rhododendrons native to this country, no other attains to larger size, hence its specific term "maximum". With us at the north a straggling shrub, 5 to 20 feet tall and having lower branches semi-prostrate, on the high mountains of eastern Tennessee and the Carolinas it becomes of tree size and sometimes boasts a diameter of a foot and with a height of forty feet.

Now that hard-surfaced roads take the tourist into the most rugged mountainous sections of the East, people who never before saw any other than cultivated varieties are annually visiting localities of natural beauty favorite or famed for their blooming rhododendron. Latter June and July is its flowering period, at which time the woods, resplendant with mature foliage, appear most inviting to those who seek shade and comfort for a brief outing or vacation. Then the tangled

rhododendron thickets with their masses of bloom, in gorgeous bouquets of delicate flowers set among dark evergreen leaves scarcely less attractive, make a sight worth traveling many miles to see. Of Greek origin, the word rhododendron means "rose tree", a name rather appropriately descriptive either of the flowers or their time of blooming which coincides with that of our wild or tame roses.

Its pale rose to white blossoms form in umbel-like clusters, 4 to 5 inches across, at the ends of the branches. Each of the 15 to 25 individuals composing a cluster are five-parted, with cup-shaped corolla about an inch in diameter, and sprinkled with light yellow or orange spots within. Then too, the upper corolla lobe differs from the others by being heavily marked on its inner face with greenish dots. They are borne on slender pedicels covered with a sticky pubescence and develop from large, scaly, cone-like buds formed the autumn before. After the bees have brought about cross-fertilization there results a brown oblong capsule, about a half-inch in length, which ripens and sheds its seeds in autumn, the open fruit clusters remaining on the branches until the following summer.

It is generally conceded that few wild trees or shrubs equal or even rival the rhododendron for beauty of flowers and foliage combined. But to many its large, lustrous, dark green leaves, clustered alternately towards the ends of the branches, appear quite as attractive and decorative as do the

flowers. Foliage of such character certainly presents an ideal background to show off its light floral display most artistically. Not unlike those of the tame rubber plant, the leaves of rhododendron, when fully developed, are thick and leathery, from 4 to 10 inches long and about a fourth as wide, having also an entire edge and a broad pale midrib, which latter is but the continuation of a stout and ridged petiole. Their under surfaces, besides having a paler green color than above, quite often show a rusty pubescence. Being somewhat tongue-shaped, they have given rise in some localities to the common name "deer tongue". Most hunters and woodsmen have observed the peculiar habit which rhododendron leaves have of drooping, as well as shrinking and rolling up during severe cold weather. But neither frost nor zero temperature does them damage and, being evergreen, they remain on the branches for several years.

Nurserymen have long been interested in this native rhododendron and have developed from it a number of distinct and beautiful hybrids. All of them are extremely popular for ornamental plantings about parks and on private estates, both in the United States and in Europe. If properly done, it is entirely possible to dig up the wild plants and transplant them successfully elsewhere. But like all others of the heath family, rhododendron seems unable to make thrifty growth on soils of limestone origin, demanding instead those of an acid reaction. Therefore, when preparing the planting site, it usually is best to remove a liberal quantity of ground and to

replace it, preferably with soil and rich humus obtained from the plant's native habitat. If that procedure is followed, and they are placed in a shaded location, mulched and given plenty of moisture, also fertilized occasionally with aluminum sulphate, plants of wild stock should quickly adapt themselves to their new surroundings.

MOUNTAIN LAUREL (Kalmia latifolia)

Mountain laurel, next to rhododendron, ranks as probably our most beautiful flowering, broad-leaved evergreen. Usually a compact, gnarled shrub, 3 to 10 feet high, with many stiff, crooked and divergent branches forming a somewhat rounded head, it thrives on drier sites than does rhododendron and commonly forms an understory in deciduous forests. It may be found growing from Newfoundland and Hudson Bay southward to Indiana, Ohio, and Pennsylvania, and most commonly South along the Appalachian Mountains and their foothills to Georgia; also, sparsely through the Gulf states to Louisiana and Arkansas. Of the five or six species of Kalmia, a purely American genus, this one alone reaches tree size and then only in a few secluded valleys between the Blue Ridge and Alleghany Mountains of North and South Carolina. There its largest specimens attain a height of 30 to 40 feet and a diameter of about 18 inches, but with crooked and contorted trunks from which lumber is never sawed.

The bark appears dark ruddy brown, but is furrowed into narrow ridges which peel off in fine shreds, exposing a cinnamon-red inner layer. This thin bark covering and also its waxy foliage causes mountain laurel to be easily killed by forest fires; but there subsequently results such a profusion of stump and root sprouts as to produce very dense thickets. While all kalmias thrive well in sandy, peaty, or loamy soils, they persistently avoid those containing lime or in which earthworms commonly exist. The genus Kalmia was named after Peter Kalm, a Swedish botanist and pupil of Linnaeus, who traveled from 1748 to 1751 in North America and became an enthusiastic admirer of this exclusive group of plants, and of mountain laurel in particular. Many have proposed the flower of Kalmia as a national floral emblem but, though as typically American as is the bald eagle - our national bird, it unfortunately is popularly known only in the eastern states.

While the mountain laurel blooms in our latitude from May 1st until the middle of June, elsewhere its flower buds begin to open from early April in southern Mississippi to the 20th of June in Canada. Its waxy white flowers, tinged with pink and showing delicate purple markings within, are grouped together in large terminal, compound corymbs, these clusters averaging from four to five inches across. So conspicuous and enticing do they appear that the traveling public annually mutilate the finer specimens standing within sight of roads and trails.

Each individual flower within a cluster is cup-shaped, five-parted, nearly an inch broad, and borne on a slender pedicel covered with sticky pubescence. The corolla consists of five united petals furnished with ten small pouches in which are situated the anthers. In form and color they suggest miniature open parasols, with the corolla corresponding to the cover, the reflexed stamens to the ribs, and the protruding central style to the handle; also, this likeness might be extended even to the flower buds, which are cone-shaped and prominently ten-ribbed, their appearance too reminding one of a closed parasol. Because the color of its showy flowers was thought to resemble some shades of calico cloth, one of the mountain laurel's common names is that of "calico bush". After bees have pollenated the flowers there results a cluster of rounded woody capsules, each about the size of a pea and with persistent style and calyx, which open about September into five divisions to release the powdery seeds, though the empty pods remain on the branches until the following year.

Not only do the flowers of mountain laurel show symmetrical beauty, but they also prove curious and interesting, particularly as regards their remarkable adaptation for cross fertilization. Harriet Keeler, in "Our Northern Shrubs", so aptly describes this arrangement that she is quoted as follows:

"As each curious, angular, pocketed corolla-cup opens, the stigma appears erect in the very centre of the flower. The anthers are all hiding their youthful heads; in fact, every one

of them is tucked into a pocket which fits it perfectly. The filaments are strained to a bow, and so delicately is the mechanism adjusted that a jar will release the anthers. Now comes the wandering bee, 'voluble, velvety, vehement', and enters the flower. The soft body covers the stigma, the weight and the motion set the filaments free, and the bee departs 'a dusty fellow' - whose legs are 'powdered with gold'. In fact the bee carries off the greater part of the pollen of that flower and deposits some of it upon the stigma of the next flower visited; and so the process goes on through all the summer day." While the flowers furnish honey, it is suspected of having narcotic properties which may make it undesirable for human consumption but doesn't seem to bother the bees in the least. Ants too try to obtain their share of nectar and pollen, though with disastrous results, for they seldom succeed in getting past the sticky pedicels where they are trapped by the hundreds.

Its leaves crowd so toward the branch tips as to surround and overlap the flower clusters, making their combined effect doubly attractive. Indeed, for decorative purposes, both the foliage and bloom of the mountain laurel have long been highly esteemed. Though much smaller than those of rhododendron, its mature leaves become thick and rigid, pointed at both ends, and average from two to five inches long and possibly a third as wide. Also they have an entire margin, prominent midrib but obscure veins, and appear deep lustrous green above, somewhat paler and smooth beneath. Being evergreen doesn't imply that

they persist indefinitely; in fact, its leaves fall the second summer. When grazing sheep or cattle eat laurel foliage usually they become very sick and sometimes fatally poisoned. Deer will not touch the leaves unless hard pressed for food, but even then the results seldom prove serious. Some hunters claim that during severe winters when grouse are forced to feed on laurel buds their flesh is rendered unwholesome.

The wood of this laurel is hard and close-grained, brittle, and its pale brown surface is said to polish well. Many small articles are made from it, such as paper knives, rulers, turned boxes for pins and buttons, lamp-stands, trays, penholders, dippers, and handles for tools and buckets. Of late years it has become popular for rustic furniture of all sorts, ranging from chairs and picture frames to gun racks. It is said that the early settlers made spoons and ladles from the roots of mountain laurel, which circumstance has given rise to one of its common names, spoon-wood. Today many tobacco pipes and cigar holders are manufactured from these roots, which often become enlarged at the root collar - the point where trunk and roots join. Laurel root wood is selected because it carves easily, is not inclined to split, does not burn readily, and darkens in color with age; it too is cheap and easily obtainable.

Its large clusters of conspicuous flowers and equally attractive foliage have made mountain laurel a most desirable ornamental plant. Massed in groups or as a single specimen on the lawn, few shrubs appear more decorative. Care

and treatment for successful transplanting differs little or none from that already described for rhododendron. Both species require acid soils and do best if placed in a partly shaded situation, given plenty of moisture, and mulched during at least the first season after planting.

PURPLE-FLOWERING RASPBERRY (Rubus odoratus)

The purple-flowering raspberry may be termed a straggling shrub of rank growth which becomes three to five feet tall. It frequents rich shady woods and moist cool slopes and glens, often ornamenting the rocky sides of mountain roads or trails with its clumps formed from underground stems. Unlike other raspberries, it has no prickles; in fact, many of its characteristics differ noticeably from those of its relatives. The recent shoots are green below, reddish above, and densely covered with long purplish clammy hairs which continue up the petioles, the under leaf surfaces, and even densely coat the flower stalks and calyx. The older portion of the stem doesn't show this glandular pubescence, but there the bark becomes pale yellow, loose and shreddy. This low branching shrub grows from Nova Scotia westward through Ontario to Michigan and Indiana, and south along the Appalachian Mountains to Georgia. It is a peculiar plant and appears very attractive as seen in its natural environment.

It bears large, maple-like, alternate leaves, five to seven and sometimes ten inches broad. These bright green and

showy leaves are palmately three to five lobed, with coarse unequal teeth, and appear soft and woolly on their upper surfaces, but hairy beneath, as previously mentioned. So large are they that many a one has been folded to serve as a temporary drinking cup at roadside springs in mountainous sections. Carried on long slender petioles, they remain practically unchanged until autumn frosts or storms destroy them.

Purple-flowering raspberry was so named because of its rose-purple flowers, one to two inches broad, borne in loose terminal paniculate clusters. In form resembling a wild rose, though with color less bright, these pretty blossoms give a charm to many a solitary spot. Five round purplish petals each with a yellow anther carried on a purple filament surround a multitude of tiny stamens. Never do they appear so showy as when found in a half-shaded situation, for direct sunlight quickly fades them. Even its unopened buds prove interesting, with their spherical bodies crowned with a flowing tassel from the five long points of the calyx. With flowers several to many in a cluster and produced freely throughout the summer, from May to September, it appears that this shrub doesn't know when to stop blooming.

Bees and other insects frequent its rather sweet-scented flowers, thus serving as benefactors in cross pollenation. Blossoms and ripe fruit occur together from July to September; but farther north or at higher altitudes it fruits until killed by frost. The fruit, as indicated by its name, is raspberry-

like but broad and flat, light red, and very insipid. Despite their dryness and acidity some people are fond of these berries. If gathered when thoroughly ripened and eaten with sugar and cream, they do seem rather tasty, though of course less agreeable than the true raspberries. Each berry averages about an inch across, is surrounded when on the stem by a fringe of dry stamens, and over its surface are velvety hairs. It too readily separates into its component drupes and also from the receptacle. The broad and shallow appearance of these fruits has suggested the name "saucer-berry" so often and appropriately given to this common woodland shrub.

WILD HYDRANGEA (Hydrangea arborescens).

A frequent associate of the purple-flowering raspberry, just described, is the wild hydrangea, an erect, wide-branched shrub of vigorous growth, usually two to four and rarely six feet tall. It grows in clumps and is most commonly found on the wooded slopes of moist ravines or rocky stream banks, from southern New York south to Florida, and west to Iowa, Missouri and Alabama. It appears to be a variable species in different parts of its range, particularly as regards the presence or absence of pubescence on its stems and foliage. Most often, though, it is entirely smooth or nearly so, with a shreddy bark on older stems, and young twigs light brown, angled, and containing a large white pith. Other helpful winter features include its opposite-branched habit of growth, sharp-

pointed appressed buds, and also the fact that its twig tips often freeze back during severe cold weather. The Latin term arborescens means "tree-like", but why it should be used as a specific name for this small, really semi-herbaceous shrub would seem rather difficult of explanation; but possibly the great botanist, Linnaeus, who first gave it this specific title, had in mind the plant's erect sturdy growth and rather tree-like method of branching.

The wild hydrangea has long-stalked ovate leaves with coarsely serrate margins, cordate at the base, acute at the apex, and ranging from three to six inches in length. On their upper surfaces they are deeply corrugated, the entire network of veins being prominently sunken above and protruding beneath. Always of a deep green color and but slightly paler below, these rather thin and delicate leaves usually are smooth or rarely downy. The foliage and some other features of this plant are suggestive of white snakeroot (Eupatorium urticaefolium), an autumn herb.

One who knows only the cultivated hydrangeas with their showy sterile flower clusters may be rather disappointed upon first seeing their wild woodland relative in bloom. Only now and then does it have a few sterile blossoms scattered around the margins of its flat-topped terminal cymes; more often there are none. Rather than to depend on sham and show for advertising purposes, the wild hydrangea instead expends its energy in developing fragrance and pollen with which to attract insect

visitors. Its flowers are white to cream-colored, and with hundreds of small fertile individuals massed together in flattened clusters, two to five inches broad, quite like those of the common elderberry. Since each tiny floret has from eight to ten exserted stamens with pink anthers, their combined effect so modified the white background of petals as to give to the bloom a pale salmon-pink shade. Usually the flower clusters develop on the stem tips, but occasionally a thrifty plant may be seen bearing small auxiliary cymes in the upper leaf axils. For wild hydrangea the high tide of bloom occurs in early July when the spring flowering period of so many other plants is virtually over.

The fruit is a small, two-celled and ribbed capsule, of course arranged in terminal clusters like the flowers. They ripen in autumn, at which time their membranous walls split open to release the many minute seeds contained within. These empty pods then persist over winter and their presence affords a helpful distinguishing feature when the leaves and flowers are not present.

(Note. Bring in pine and hemlock cones, acorns, and other available tree seeds for illustration - encourage questions.)

(c) Reforestation.

Earlier we discussed how forests reproduce through sprouts from stumps and in some cases root suckers. A forest once destroyed and the ground cleared, comes back to forest trees slowly. Often the trees seeding in are knotty through wide spacing, and of inferior species. Natural reforestation is often unsatisfactory. Artifical reforestation or the planting of forest trees is sometimes the only way of securing a forest stand of the proper density and of desirable kinds of trees.

In order to secure small trees at reasonable cost for forest planting, forest nurseries have been established principally by government agencies. Ornamental nurseries failed to meet the reforestation challenge in quantity or cost of tree seedlings.

The first step in artificial reforestation is the collection of the seed of the desired species of trees. It has been discovered that there is a large variation in the strains of a tree species. In one locality Scotch pine grows crooked and limby, while in another locality it grows straight and clean. Seed from the crooked trees may produce crooked

trees. It is, therefore, important for foresters to either collect their own tree seed, from the best parent trees or when that is impossible, secure it from reliable dealers with certified sources of the seed.

Forest tree seeds are sometimes expensive. Some pines require a bushel or more of cones to produce a pound of clean seed. In the case of the cone bearing trees, the cones are collected from the trees by fastening a sharp triangular mower blade on the end of a pole and cutting them off. They are collected green before they open on the trees. The cones are then placed in racks in a heated room, when they crack open and the seed falls out. Where there is much warm fall sunshine as in the west, cones may be spread on floors or tarpaulins in the sun to dry out and crack open. The seed with their membraneous wings are then rubbed in bags to loosen the wings which are afterward blown out of the seed by a hand windmill, or merely pouring the seed from one container held high above another when a good breeze is blowing. The size of pine seed varies by species. They may be smaller than a grain of wheat, or in a few cases larger than a grain of corn. They vary from 800 to the pound in the "nut" pines and "stone" pines ot 130,000 in our northern Banks or "Jack" pine. Pine seed is collected from late August on and is stored to advantage in a cold storage warehouse until planted in the spring.

Other seeds ripen and are collected at different seasons. Elm and maple seed ripen in the spring and must be sown at once. Acorns and walnuts are gathered in the fall and are best fall sown to avoid storage. Some seeds must be kept in moist sand over winter when wanted for spring sowing.

Fall sown acorns, walnuts, hickory nuts and other tree seeds that squirrels like, must be protected when the nursery is near the forest. A half inch mesh wire netting laid over the top of the bed will turn the trick. Squirrels always want to dig straight down and do not burrow under the screen wire from the side as mice do. When mice are bad they may be either fed poisoned grain or the seed bed enclosed in fine wire screens.

Before conifer seed is sowed it is tested for germination to determine the right quantity to sow per bed of a given number of square feet. If sowed too thick seedlings are spindly - if sowed too sparingly, weedings and other costs will make the small number per bed cost too much.

Nurseries should have an overhead pipe sprinkling system to maintain uniform moisture conditions during the first year for coniferous seedlings in Pennsylvania. Hardwoods producing a large seedling the first year are more often not watered.

Coniferous seedlings have shade frames placed over

the beds, the first summer, and are covered with straw or pine-needle mulch over the first winter to prevent repeated thaws from "heaving" them out of the soil.

Seedling trees should be 8 inches to 2 feet in height for average forest planting conditions. Some of the conifers require 3 years in the seed bed, or seed bed and transplant (explain) bed. Hardwoods can often be transplanted at the end of the first year.

For forest planting the forester spaces the small trees 4 x 4 feet to 6 x 6 feet for clear timber production. 6 x 6 feet planting takes about 1200 trees to the acre and should be planted at a cost of about $8.00 an acre in Pennsylvania, including the cost of the trees at $3.00 per thousand. In the south in the sandy soils free of stone and brush, and with large one year pine seedlings planting can be done for considerably less.

When abandoned agricultural land is reforested the planting needs little attention except to keep in check occasional attacks of insects and disease, until the trees are large enough and have shaded out the lower branches so they require a thinning. This is usually when the trees are 4 to 6 inches in diameter.

When conifers are planted on devastated hardwood forest soils, because of the slow early growth of the conifers,

the scrubby competing hardwoods must often be cut back one to three times to give the planted trees full sunlight.

Most of our early forest planting followed the German practice of planting all trees of the same species on one area (pure stands). Because insect epidemics and tree diseases are more apt to do great damage in pure stands, the best modern practice indicates mixed planting as a rule. Maintenance of a good forest soil over long periods also seems to demand mixed planting.

One or more broadleaf species are good to mix with conifers in planting as the leaves from broadleaf prevent the formation of an acid raw humus typical of pure conifer stands. European foresters often plant beech seedlings under pure spruce or pine stands, not for the wood, but because the beech leaves will assist in the soil building process.

At the Pennsylvania State Forest Experiment Station at Mont Alto, experiment plots in pure planted stands of white pine and Scotch pine have been underplanted with hemlock and sugar maple. Further underplantings are contemplated in pure pine stands to determine the long time effect of such mixtures on the forest soil, and resulting timber growth. Many coniferous plantings have been started on hardwood areas and the resulting forest will be a mixed forest. America has many excellent timber species that Europe lacks, and satisfactory data on the best tree mixtures can be determined

only after long time experiment.

Some knowledge of tree diseases and insect attacks is necessary to determine the advisability of planting this species or that species or better a mixture. One would be foolish to plant chestnut in the eastern United States at present because of the 100% destruction by the chestnut bark fungus (blight). In some areas because of the white pine blister rust, white pine planting is hazardous unless the gooseberries and currents can be completely eradicated. Red pine may be desirable to plant with white pine because its terminal leaders are not killed back by the white pine weevil. These are examples of the facts to consider before going ahead with artificial reforestation on any but an experimental basis.

(d) Questions (10 mins.) Identification of miscellaneous material. If the men do not bring in specimens, the forester should bring in a series of related or similar tree specimens and ask for their names in review, again pointing out distinguishing characteristics. Repetition is required to enable the men to get the desired knowledge. Bring in the oaks one period; the maples another; the conifers another, walnuts and hickories another; ashes and sumacs another, etc.

(e) Field Trip. The field trip should be to a forest nursery if possible. Show how forest tree seed is collected, extracted, stored, sowed, and planting stock produced. The cultural work, shading, watering, weeding, spraying (discuss disease), cultivating, lifting, packing, costs, cost of planting per acre, should be discussed again.

LESSON 10. (a) Development of Forest Property and Municipal Forests.

It is interesting to trace the development of property rights to forest areas in Europe, from the time when all forests were nobody's property, but were the common hunting and fishing grounds of the semi-civilized tribes. Finally roving tribes settled in villages and the woods surrounding the villages were held as common village property known as the "Mark" in Germany. Sometimes this forest land was later (12th century) divided into individual farmer woodlots and joined to the cleared homestead. Often it continued to be held "in common" with the old families finally exercising what became legal rights ("prescriptive rights") to a certain amount of wood each year from the village forest. Some of these villages ("commons") forests in Germany continue down to the present as municipal forests owned by the town but subject to these very bothersome "rights" to a certain amount of wood. In some instances these rights have been bought out by the town to give the forest management a clear field to put the forest in order.

Wars broke out between neighboring tribes or communities, leaders developed, and when the property of the subjugated people was divided the leader often received the larger part. The conquered people often became serfs. Thus powerful princes arose with large forest properties and finally

IRREGULAR PAGINATION

the most powerful one allied himself with others and became king of the region. The king built up conquered forest property into royal forests reserved for hunting by the king.

Similarly Bishops and other religious leaders developed landed estates and forest properties. At the same time cities developed which became wealthy. These loaned money to kings and nobles, and when repayment was difficult, sometimes were granted areas of royal forest in payment of the loan. Thus arose a second source of city or municipal forests in Central Europe.

The first reason for recognizing forests as of personal value, was the hunting rights. Then the oak and beech forests took on a value for fattening hogs on the acorns and beech-nuts. Finally as fuel wood became scarce locally, nearby forests took on value for fuel and later for construction timber.

The early seizing of the hunting rights by kings and their separate control from the timber rights, led to the buying and selling of hunting rights and fishing rights by wealthy citizens, and the denial of the peasants rights to hunt and fish even in municipal and state forests. This situation persists in European forests even today, and is in striking xontrast to the modern developed rights of the american citizen to hunt and fish on national, state, and municipal lands and on much of the unenclosed private forest as well. The lack

of hunting and fishing privileges does not deter the European common people from using their state and municipal forests, and many private forests as well, for picnics, outings, and recreation.

In a previous discussion was mentioned the Zurich town forest known as the "Sihlwald", some of which has belonged to the city for 500 years! During this period the coniferous forest was reduced and beech was introduced 150 years ago for fuel wood and now forms 60% of the forest and other hardwoods 15%. Since wood fuel is in less demand the forester is again gradually increasing spruce and fir.

This forest lies along a ridge between the blue waters of Lake Zurich and the Sihl river. It has 22 brooks coursing through it and is within easy electric road distance of the city. The lime of the soil gives the waters of lake and river a wonderful blue, which adds to the charm of the adjacent forest. This forest has netted about $6.00 per acre or $25,000. per year - in addition to providing a wonderful recreation service to the city.

Switzerland is the country that stands out preeminently in the ownership of municipal (communal) forests. These commercial forests embrace 68% of the entire forest area of the country. The state (canton) forests include 5% and private forests only about 27% of the forest area. Because of

the rugged country, and the democratic ideas of the people, the social value of forests has dominated the private property idea. Not only are the privately owned forests only 27 percent of them whole, but even this is strictly controlled in its cutting by the government in many protection areas.

Another commercial forest in Switzerland worth visiting is that of Biel on the lake of the same name. The forest produces 80 cu. ft. (almost a cord) per acre and year. It contains beech, fir, spruce, larch and some pine.

The Couvet Communal Forest has been under manag ement only since 1870, but already is the Mecca for foresters to see the magnificent fir and spruce and a selection method of cutting which produces a maximum amount of valuable saw timber and a minimum of small sized, low value thinnings. In 1924 this forest was handled by Dr. Biolley, famous among world foresters. Fire wood from this forest sold for the equivalent of $20. per cord. With lower wages than in the U.S. one can readily see how much farther European forestry can go in intensive work than we can, at least, at present.

In Germany the Heidelberg City Forest is worth visiting among the multitude of town forests. In 1600 the hills about the city were bare except for chestnut orchards here and there. In 1791 - 142 years ago, the first working plan was made. It was entirely a hardwood forest then - over half sprout growth cut for fuel. Gradually the forest has been

changed to a larger amount of high forest - largely conifers. The foresters have introduced many american species for experiment; though white pine is widely planted and is beyond the experimental stage. Douglas fir from our Pacific Coast forest is grown as a regular timber tree. Italian chestnut occupies small areas and propagates itself. But the experimental plots of yellow poplar, Lawson cypress, eastern hemlock, and red oak are most interesting. The hemlock plot is producing 310 cu. ft. and the Douglas fir 400 cu. ft. per acre and year, - almost incredible wood production. Several California redwoods - one over 3 ft. in diameter - are doing well.

The most interesting thing to an American Forester in 1924 was the last compartment of the old devastated hardwood forest, not yet treated by the foresters. It looks just as bad as our burned and cut over lands here, and made a wonderful contrast with the fine timber near by.

This discussion of municipal or town forests in Europe could be extended to include town forests in Sweden, France and other countries. In some small villages the village forest income makes local taxes unnecessary.

America was not discovered until national governments had developed and dominated the government field. England early controlled northern America and communal forests had not

gained the foothold in England that they had in Central Europe. The land in America was crown land, granted to individuals (Wm. Penn) and proprietors. When the U.S. became independent the eastern states (the 13 original colonies) claimed the crown lands which had not passed to private owners. Lands west of the 13 original colonies were claimed and disposed of by the U.S. Government (Texas excepted), Thus there was no early development of town or city owned forest.

It is only recently that towns in the United States have begun to feel the need of municipal forests;

(1) For the protection of the water-sheds for their domestic water supplies, when the water plant is town owned, and

(2) For recreation when the cities have grown to large size.

The municipal forest lands now must be either bought or received by gift from public spirited citizens.

New York is building up a city park forest along the palisades of the Hudson - mainly for recreation.

Chicago is building up a series of forest parks, as is Cleveland. But few of these municipal forests in America have yet developed the impetus of timber growing as an important function along with water supply protection and recreation. There is an open field for this sort of develop-

ment, and some progress is being made by smaller municipalities. Fitchburg, Massachusetts claims to have the oldest community forest in the United States, dating back to 1914. Ninety-three of the towns and cities of Massachusetts in 1932 owned forest land of greater or less extent. The total area thus owned in that state is more than 26,000 acres, on which more than 4,000,000 trees have been planted, and several hundred men receive useful and productive work as a means of unemployment relief.

New York state has more than forty city and town forests. Vermont has 24. Colorado, Ohio, Maryland and New Jersey are other states where the community forest idea is becoming popular. More than 35,000 acres of forest are owned by N.J. cities and towns.

In Pennsylvania twenty one towns and cities own forest lands, primarily in connection with their water supply facilities. Allegheny County and the city of Pittsburgh are developing a considerable area for park and recreational purposes, and has planted many thousand trees thereon under forestry supervision.

Bradford in McKean County has the largest area of community forest. Reading has planted the greatest number of trees, in developing its city forests which lie around the city water supplies. Altoona, Mt. Union, Coudersport,

Hanover, Waynesboro and Chambersburg are examples of other Pennsylvania municipalities owning forest lands for community purposes.

In 1932 a new law was passed to encourage county ownership and development of tax forfeited forest lands. It is still too early to predict what results this may bring.

(b) Tree and Shrub Identification; broadleaf simple alternate leaved trees, completed; willows, persimmon; shrubs - meadow sweet.

THE WILLOWS (Salix sp.)

The genus Salix comprises some 170 or more species of willow found chiefly in the cooler parts of the north temperate zone. A few dwarf species show arctic distribution; so also do several inhabit only the southern hemisphere. Of this recognized number, North America is credited with having from 70 to 100 different kinds, about half of the willows known to occur in the world. Some others, possibly a dozen or more, have been successfully introduced from Europe and may be seen planted almost everywhere in this country as ornamental trees. Of versatile character, our native willows range from sea level to high altitudes; also, they are distributed from Mexico to the bleak coasts of the Arctic Ocean. One may find them growing along streams and about swamps and ponds; or, in cold bogs, on dry sand dunes, and even on the alpine summits of mountains. Most of them, however, show a preference for moist habitats, and it is in damp situations that the average person thinks of looking for willows.

In size the willows vary from tiny shrubs to trees of large proportions. The arctic species are said to be among the most diminutive of woody plants, in some cases being scarcely more than a few inches in height. While most of our native varieties deserve to be classed as shrubs, about 24 American representatives are credited with attaining the size and habit of

trees. But even the latter, as for example the black willow, may be large trees in some sections and elsewhere become only a few feet high and an inch or two in diameter. Others only rarely reach a size sufficient to place them in the tree class. Very few indeed yield saw timber or attain to commercial importance, due not only to insufficient size but also to other reasons such as their usual poor form and early susceptibility to heart-rot. Some of the introduced willows do, however, commonly grow into large trees.

Where they occur naturally, most all willows have a tendency to grow in clumps and to form thickets. So also do they usually have clustered stems; that is, instead of one there will be several or many trunks arising from the same base. But each individual stem appears so straight and sparingly-forked as to give to the willows a form of growth which differs considerably from that of other trees. Trunks and limbs often are densely clothed with water sprouts; they too are usually crooked or lean noticeably, and seldom grow erect. While members of this group make rapid growth, they too are short-lived and older trees exhibit many signs of deterioration. Even though scarred and crippled in appearance, they cling to life tenaciously and often are able to repair broken parts or sometimes to replace them with new growth. They may be hollow or otherwise defective, and storms may have completely shattered the trunk, but so long as any green bark remains new shoots will appear to prolong the struggle. Young willows are usually pliant and tough but the

wood of old trees becomes stiff, brash and brittle.

Because of its tannic acid content, willow bark is of some value for tanning leather; it also yields salicin, a bitter tonic principle, used much like quinine in medicine. The appearance of the bark is quite similar on all species, hence it becomes of little or no assistance for purposes of identification. Instead the twigs and buds serve as more reliable winter features. The twigs are long, slender and flexible and often separate easily at the joints. Arranged alternately along them are the buds, each with but one hood-like, non-resinous scale, usually duck-bill shaped, and with the terminal bud absent. The narrow leaf scars, each containing three bundle-scars, also are characteristic. In summer these twigs carry long, narrow, often sickle-shaped leaves on short petioles. At the base of the leaf-stalks occur stipules or small leaf-like appendages which, according to their form, absence or persistence, become of importance in determining species. Frequently the leaves have, on their under surfaces, a covering of fine silvery hairs or a whitish bloom, so that every breeze causes the foliage to display a pretty contrast of color and to ripple and billow as only the willows can. In autumn their leaves turn light yellow or else fall with little or no change of color.

This is a family of two households; or, in other words, male and female flowers occur on different trees. Both kinds, namely pollen-bearing and seed-producing, are arranged in drooping tassels - a feature that is characteristic of no other

family of woody plants. Possessing neither calyx nor corolla, the tiny flowers composing these catkins represent the barest essentials for perpetuation of the species, since they contain only stamens or pistils. The pollen-bearing flowers usually are yellow to reddish in color and have one, two, or three to ten stamens; the seed-producing ones generally are green and consist of a single pistil, composed of two carpels and two more or less divided stigmas. Though the flowers yield nectar, both wind and insects, the latter particularly bees, assist in pollination. The catkins appear either before or with the leaves, in early spring; they fall off as a whole, the staminate after flowering, the pistillate after ripening and scattering of the seeds.

The fruit consists of small capsules arranged in drooping tassels like the flowers. They ripen in late spring at about the time when the foliage has matured. Each capsule splits into two parts and releases a multitude of tiny seeds which are equipped for flight by being provided with a tuft of fine silky hairs. So light and fluffy are these seeds with their attached parachutes that the wind carries them like thistle-down for long distances; so also is water an important agency in their distribution. The seeds of all willows are exceedingly short-lived and, unless suitable soil and moisture conditions are provided within a few days they leave the pods, their tiny green embryos easily dry out and hence are unable to germinate. Where favorable conditions are encountered youhg seedlings may reach a height of two or three feet at the end of their first

growing season.

While the willows are not so valued for their wood products as are many of our trees, they have other properties which fit them for special uses. They are noted for their unusual sprouting ability and will grow quickly from either root or shoot cuttings. If a live piece of willow, whether it be a twig or a piece as large as a fence post, is placed in the ground it will readily take root and throw up new shoots which can develop into thrifty trees. Man has long utilized this remarkable faculty of the willows for such purposes as protecting steep embankments from erosion, holding stream banks in place, or preventing the movement of shifting sands. They have very extensive root systems and when well-established these long, tough, and matted roots make excellent soil binders.

Possibly the greatest value of the willows lies in their flexible tough shoots, commonly called osiers, which serve admirably for making baskets and wicker furniture. Certain species have for centuries been extensively cultivated in Europe for such purposes and of late years this industry has been revived in America. While the art has been known here since the time of the Indians it was never developed so efficiently as for instance in France, Belgium and Germany, Because the willows predominate along streams it was but natural that their long slender stems should be early utilized for constructing fish-weirs. Various species have also been planted for windbreaks in the prairie regions of the central west. The wood, being light, soft and non-durable, is of little commercial

importance, except for box boards and excelsior; formerly charcoal made from it was much prized for the manufacture of gunpowder.

While the willows as a group may be easily recognized, the different species resemble each other so closely and hybridize so frequently that only the expert can distinguish one from the other with certainty. It is for that reason that only a few of the commoner and more readily determined species will be discussed in this lesson, and they may be separated as follows:

IN WINTER

1. Buds conical - acute .....Black Willow (S. nigra).
1. Buds duck-bill shaped .....2 and 3.

2. Twigs fine, drooping, weakly attached to branches .....Weeping Willow (S.babylonica)
2. Twigs somewhat coarser, not so noticeably drooping, and more firmly attached to branches ..... 3.

3. Mature twigs yellow and quite brittle .. Crack Willow (S. fragilis).
3. Mature twigs reddish-purple to dark green, and rather flexible ..... Pussy Willow (S. discolor).

IN SUMMER

1. Leaves narrowly lanceolate, finely serrate, and green beneath 2
1. Leaves broadly lanceolate, coarsely serrate, and with a silvery bloom beneath 3

2. Leaves almost the same shade of green below as above; prominent earshaped stipules often persistent ..... Black Willow (S. nigra)
2. Leaves much darker above than beneath; stipules minute and fall early; very long drooping twigs .....Weeping Willow (S.babylonica).

3. Leaves tend to be elliptical, with rather abrupt tips and ruffled margins; a shrub or small tree ..... Pussy Willow (S. discolor)

3. Leaves with long tapering tips and margins not ruffled; becomes a large tree ..... Crack Willow (S. fragilis).

BLACK WILLOW (Salix nigra).

This species ranks as unquestionably the most important willow native to America, which distinction it holds because of its larger size and wider distribution than any of the others. But in reality that isn't saying so much, for even it usually is too small or otherwise undesirable for saw timber, except to a limited extent within the lower Mississippi Valley region; there it becomes most abundant and of largest size, specimens a hundred feet tall and with a trunk three feet or more across having been recorded. Elsewhere the black willow might best be termed a small to medium-sized tree, though occasionally large individuals may be found in other parts of its range which extends from New Brunswick to Florida and west to the Dakotas and Texas.

Like so many other willows, it prefers moist situations and deserves to be classed as one of the most common trees which frequent stream banks and the margins of ponds, lakes and swamps. Other trees usually associated with it include river birch, sycamore, black ash, and also the red, silver and ash-leaved maples. Frequently the black willow takes almost complete possession of islands, sand bars and mud flats, being able to tolerate either low water conditions or swollen streams laden with ice and debris. Its clustered

stems and spreading upright branches give to its crown a broad and irregular outline which is quite characteristic of this willow. Both the common name and specific term "nigra", the latter meaning "black", refer to the bark which becomes dark brown to nearly black, as well as thick, rough, and deeply divided into broad flat ridges.

This tree may be known by its fine, slender twigs bearing in winter sharp-pointed conical buds about an eighth of an inch long. The twigs are so brittle and easily broken off that after every storm the ground beneath a black willow might be littered with them. If these twigs fall on wet mud or in damp situations they soon take root and are able to grow into young saplings. Many of them drop into moving streams and may be transported long distances before eventually becoming lodged along the banks. This reproductive feature of black willow, probably more so than its seed regeneration, helps to account for the tree's wide distribution and predominance along stream-courses. The feature too has a practical value which has been employed most extensively for protecting the maze of levees along the lower reaches of the Mississippi River. For this purpose the twigs and branches are bound together in huge raft-like mats called "mattresses" and then buried on the banks, thereafter resulting in a network of roots so dense as to bind the soil in place and thus prevent damage from the washing action of waves.

Black willow has leaf features which serve to dis-

tinguish it from other common tree-like members of the genus Salix. Its narrowly lanceolate leaves taper gradually to a long point, and have the margins closely set with fine sharp teeth; also, the glossy green color of both their upper and lower surfaces furnishes a helpful aid in identification. Carried on short petioles, they average from two to four inches long but only an eighth as wide, and often the slender blade is curved like a sickle. All willows bear stipules - pairs of small appendages at the base of the leaf stalk - which may be either scale-like and deciduous or else leaf-like and persistent; as a rule, however, few, if any, appear more conspicuous than do those of the black willow. Its rather large and ear-shaped stipules clasp the twigs in a characteristic fashion and, while they usually are present and remain throughout the growing season, occasionally one finds a tree that produces only the small scale-like appendages and they soon fall off.

The flowers appear in March or April, and usually before the leaves have become more than half-developed. Those of both sexes occur in slender drooping tassels, from one to three inches long, which terminate the young leafy shoots. While the staminate trees drop their catkins soon after the flowers have produced pollen, it requires about a month thereafter for the pistillate trees to mature their fruit. Then the tiny capsules open and release the feathery seeds contained within and wind and water scatter them far and wide. Regarding

their dissemination by water, it is of interest to note that Thorean observed these minute seeds to "drift and form a thick white scum, together with other matter, especially against some alder or other fallen or drooping shrub where there is less current than usual. There within two or three days a great many germinate and show their two little roundish leaves, more or less tingeing with green the surface of the scum, somewhat like grass seed in a tumbler of cotton. Many of these are drifted in among the button bushes, willows and other shrubs and the sedge along the river side, and the water falling just at this time when they have put forth little fibres they are deposited on the mud just left bare in the shade, and thus probably a great many of them have a chance to become perfect plants".

Black willow, like its kindred, produces a light and soft wood which is weak and also splits readily. Only a little of it is sawed into lumber and much of that which does enter the market passes as cottonwood. It unquestionably finds its greatest use in the making of boxes and crates, but also is used to some extent for excelsior, woodenware, slack cooperage and furniture. Each year a small fraction of the total output goes into baseball bats; the players term them "fungo" bats and they are used only for hitting out balls in practice. Its lightness and the fact that it doesn't warp, check, or splinter easily also has caused this wood to be manufactured into such articles as toys and artificial limbs, where strength becomes of secondary consideration.

PUSSY WILLOW (Salix discolor).

While to the witch hazel belongs the distinction of being the last woody plant to bloom in autumn, among the very earliest wild flowers of the year are those of the pussy willow. When one is listening for the call of the first robin or the song of the bluebird, to see this shrubby little willow brave the cold March winds in order to hang out its furry catkins gives a renewal of faith that spring is here. These slender flowering shoots, leafless but arrayed with silvery "pussies", are gathered in armfuls by children of rural districts and likewise make a strong appeal to all others who love the out-of-doors. To many a grown-up country boy whose later activities have confined him to the desk, the office, or the factory, "pussy willow" revives memories of swollen trout brooks and the dandy willow whistles that he used to make in early spring when the "sap was up".

This is one of the largest of the shrubby willows, being usually a many-stemmed bush from 6 to 12 feet tall, but may sometimes become tree-like in habit and has been known to reach a height of 25 feet and with a corresponding diameter of 8 inches or more. When it does assume the stature of a tree, its smooth greenish trunk is most often short and bears numerous upright or arching branches which result in an open and round-topped crown. Distributed generally on low, wet land or stream banks, its pressure is almost always an indication of water, either on the surface of the ground or a little beneath it. Ranging from Nova

Scotia south to Delaware and west to the eastern edge of the Great Plains, within that wide area no other of the perplexing smaller species of this group is more common and well known than is the pussy willow. It bears stout, reddish-purple twigs which, though downy at first, later appear smooth and carry a few scattered orange-colored lenticels. Its leaf buds are of the duck-bill type and also dark-colored, in fact nearly black, while those which contain floral parts invariably become larger and fuller and have acute tips.

In point of characteristics the pussy willow is distinctive throughout all seasons of the year. In summer it may always be identified by its contrastive foliage, the leaves being dark green above and silvery-white or glaucous below. For this reason it often is called "glaucous willow"; also, the same feature accounts for its specific name discolor. In addition, the leaves of this small willow have somewhat of an elliptical shape, and with margins nearly entire or sparsely toothed and often appearing ruffled. They also average three or four inches long and about half as wide, are entirely smooth when mature, prominently veined, and borne alternately on short petioles. The small, half-moon-shaped stipules which accompany the leaves in early spring usually drop off before mid-summer has arrived. Often large cone-like galls, an inch or more long and almost as broad, form at the tips of the branches of pussy willow; these growths of stunted and modified leaves, crowded together and overlapping each other, result from the stings of insects, and within may be

found the larva of a gall-fly.

Regardless of other characteristics, however, the pussy willow will always be best known and most admired for its early spring flowers. During a brief period then it becomes a rather conspicuous part of the rural landscape; when its delicate shades of green and yellow and silver mark the water-courses and moist spots on the adjoining hillsides. It and the black alder, growing together in wet locations, run a close tie for first place honors at the head of the annual procession of flowering trees and shrubs; even then, their common associate, the lowly skunk cabbage, has preceded either of them by several weeks or more, for as early as February this foul-smelling herb pushes out of the mucky ground the dark incurved horns of its shell-like spathe.

While all of the willows have their flowers in somewhat similar catkins, no other is so early or bears such large and showy ones as does the pussy willow. Its staminate and pistillate clusters not only look different but also appear on separate trees; the pollen-bearing are a bright and fluffy yellow,the seed-producing silky and gray. Both kinds of catkins are densely-flowered,erect,cylindrical,and about an inch or more long; also, they appear before the leaves unfold, and on twigs of the previous season's growth. The scales of the blossoms are clothed with long shining hairs and it is the overlapping of these hairs that makes the soft silken fur of the gray "pussies".

It has been noted that the earliest bees and butterflies of the season

become frequent visitors of the pussy willow, for they find in its flowers their firest harvests after their long winter's rest.

Those who desire a charming winter decoration, and wish to produce the signs of spring while wind and storm still rage outside, should bring indoors some pussy willow cuttings in December or January and place them in water in a warm room. Before long every flower bud will begin to swell and soon thereafter the fluffy catkins push out from under their dark protecting scales. Slowly they expand, with the tiny yellow stamens and tongue-like pistils becoming disengaged from their silken wrappings, until at length they reach maturity and finally, with no insect visitors to cross pollenize them, they wither and fall. Thus it is possible to make them bloom out of season, there being enough stored-up nourishment in the twigs to "force" the blossoms in mid-winter. In fact, this practice has long been followed by florists and others who cater to the wishes of the public for winter bouquets and floral designs.

The pussy willow produces wood which is of no special commercial importance and which seldom becomes utilized for any purpose whatsoever. For landscape plantings, however, it has a decided value and therefore is worthy of more extended cultivation than has been given it heretofore. Though occurring naturally on moist ground and being most thrifty there, it too may be planted and made to thrive in rather dry situations. But no formal planting arrangement can ever quite equal the unique beauty and charm of the pussy willow as seen growing in its natural environment.

CRACK WILLOW (Salix fragilis)

The crack willow, known also as gray willow and brittle willow, is a native of Europe and northern Asia. Even before the Revolutionary War it was introduced into this country under various pretences, at first for basket making and later for hedges and also charcoal to be used in powder making. It too has been widely planted as a shade and ornamental tree, as well as for windbreaks and shelterbelts, posts, fuel, and farm building construction in the prairie regions. The tree is now well established through cultivation and frequently may be seen growing wild in eastern, central and northern United States. It and the white willow (S. alba), another exotic species, often hybridize and consequently are easily confused; indeed, many so-called white willow plantations have been identified later as crack willow; both have yellow varieties often seen in cultivation.

This foreign willow possesses many desirable features such as its large size attainable, rapid growth, and upright form. It also shows a relative freedom from side branches or water sprouts when fairly closely planted, hence is capable of yielding cleaner and less knotty timber than most others. Because its bark contains the most tannin of any of the tree willows of Europe, it there is valued for tanning leather, especially in Russia, France, Denmark and Germany. All these characteristics have served to recommend the crack willow to European foresters who long have considered it as one of their important hardwood species

While the tree has not, under American conditions, measured up to all expectations previously conceived for it, nevertheless it deserves to be rated among the more valuable willows to be found in this country.

This is one of the largest of our naturalized willows, becoming frequently 50 to 70 or sometimes 80 feet high, and with obliquely ascending branches which tend to make it a tall and graceful tree. It grows best on fertile and moist soils and has become quite common along the banks of streams. Its trunk is covered with a thick gray bark which breaks into rough and plated ridges. One of the best ways to distinguish crack willow, however, is by means of its twigs; greenish-yellow in summer, a clear bright yellow in winter, and always smooth and glossy. They appear to be somewhat coarser than average for a willow and have a bitter taste. The yellowish buds too are helpful, being of the appressed duck-bill type, of medium size and rather pointed. From the very brittle nature of its twigs and branches the crack willow has derived both its common and scientific names. Indeed, the twigs of no other snap off at the base quite so readily. Every wind storm litters the ground with them. They quickly take root in soft wet mud, and it is by such vegetative propagation that this willow becomes increasingly more common along stream courses.

The foliage of crack willow possesses several quite distinctive features. The leaves average large, from three to six inches long and about one-fifth as wide, and have somewhat

the appearance of peach leaves. Along their margins are fine, knobby and inflexed teeth, usually described as glandular serrate. Two tiny excrescences or wart-like knobs occur on the petiole, just at the base of the leaf blade. At maturity the leaves become smooth and yellowi sh-green above, but appear grayish to almost chalky-white beneath, on account of the dense covering of minute silvery hairs. So extremely fine are these tiny hairs on the lower sides of the leaves as to present quite the appearance of a glaucous bloom; sometimes the young twigs too are coated with them. Every breeze causes the foliage of crack willow to display this pretty contrastive coloring; also, the effect is more noticeable because its rather stiff twigs do not sway so readily and hence more motion comes from the leaves. Some other willows having long pendant twigs never show this effect because their branches and foliage sway in unison with the wind, while their drooping leaves exhibit only a listless motion. The sparkling color of the crack willow's foliage, as it ripples and billows in the wind, gives to the tree a bright and cheerful aspect.

The catkins of crack willow appear with the leaves in April. They are quite slender and vary from two to three inches in length. Staminate trees are said to be rare in America and hence it is seldom that pistillate specimens can bear good seed. Whether or not fertile seeds are produced, the goldfinches seem to enjoy them immensely. Roving flocks of these birds congregate on crack willows about the time that

the first crop of dandelion has gone to seed. Then it is that the tiny seed capsules of this willow are opening and the goldfinches seem to enjoy them immensely. Roving flocks of these birds congregate on crack willows about the time that the first crop of dandelion has gone to seed. Then it is that the tiny seed capsules of this willow are opening and the goldfinches have a jubilant time in its branches for days at a stretch.

WEEPING WILLOW (Salix babylonica)

Almost everyone knows this broad-topped, spreading tree of weeping habit which is so commonly planted as an ornamental. Perhaps no other foreign willow has been more widely introduced or become so readily naturalized in this country. A native of Asia, it grows here to a large size, often from 60 to 80 feet tall, and with a rounded head almost as broad as it is high. Usually the trunk separates into a number of large divisions which arch at the top with a graceful sweep of branches and terminate in a mass of fine drooping twigs, sometimes yards in length and almost touching the ground. Thus draped with these great locks of branchlets, hanging in festoons like Spanish moss on the trees of southern swamps, a venerable weeping willow does indeed present a singular and striking appearance. Lithe and supple, its long branchlets sway with the slightest breeze, and to observe them writhe and twist in a violent storm is rather an awe-inspiring sight.

One may always recognize the weeping willow by the graceful beauty of its outline and by its floating tresses of delicate foliage. In fact, there is no other tree of drooping tendency quite so remarkable or which can exhibit a spray of such perfect pendulous character. It is this difference of habit and variation from the ordinary which gives to the weeping willow a uniqueness and individuality. Hence, closer examination to identify it seldom becomes necessary, except in the case of young trees which have not yet acquired the picturesque form. If it be in winter, then the olive- green branchlets, arrayed with small and closely appressed buds of the duck-bill type, should prove helpful. At the base of each bud will be noticed a narrow band which serves to distinguish the buds of this willow from those of any other. While the young branchlets are tough and pliable, with age they become very brittle.

When laden with foliage the long flexible twigs of weeping willow droop perpendicularly. Each individual leaf is very slender, from three to six inches long, pointed at both ends, and with the margins covered with fine sharp teeth; at maturity they become smooth and light green above, but remain paler and glaucous beneath, and are attached to the twigs by short, twisted and somewhat hairy petioles. A most noticeable feature of the foliage is the way it covers the branches with a flowing drapery; always do the leaves lay close, and they seem to fairly drip from the twigs. This willow, among the first to mature its plumy foliage in spring, also retains its leaves yet when those of most other trees have been cut down by autumn

frosts. Throughout the whole summer may be heard among its boughs the notes of the oriole, the warbling vireo and the yellow-bird, all of which love to suspend their hanging nests from the pendant branches of the weeping willow.

Few trees there are about which more sentiment clusters than the weeping willow. It has ever been the classical symbol of grief and despair. Poets and writers of all countries have assigned to it a part in many a romantic scene, usually linking it with forbidden or unrequited love and giving its spray a fanciful use as a garland for disappointed lovers. Marking the site of many an old homestead, long since in ruins, there yet stands a weeping willow or two, making invariably a picture tinged with gloom or sadness. This willow with its drooping form, presumably depicts the bending or bowed attitude of one who is weeping. It is for that reason that we often see the tree growing in cemeteries or occasionally carvings of it on grave-stones. It too has been employed in funeral paintings. In Korea, so it is said, they plant avenues of weeping willow which lead to the tombs of royalty. So also did the great Napoleon, during his exile on St. Helena, sit in gloomy silence beneath a large willow of this species. Many think that the tree derived its name from the Hebrews lament in the 137th Psalm, when they were sorrowing captives by the rivers of Babylon:

> "By the waters of Babylon we sat down and wept,
> when we remembered thee, O Zion! As for our
> harps we hanged them up upon the willow trees
> that are therein".

In this connection, McFarland says: "It may be that the forlorn Jews did hang their harps upon the tree we know as the weeping willow; but it is open to doubt, for the very obvious reason that the weeping willow is distinctly unadapted to use as a harp rack, and one is at a loss to know just how the instruments in question would have been hung thereon".

Probably just as often as it depicts sadness, the weeping willow awakens in the mind ideas and images of a quite different character. Certainly the warm hues of its foliage would be more likely to induce cheerfulness than would, for instance, the dark sombre appearance of the fir or the yew. It is Thoreau's opinion that "it may droop - it is so lithe and supple but it never weeps". At times the sight of this willow, particularly if it be a veteran of large size, suggests dignity or grandeur and thus becomes an object of admiration. Rather than to think of its being planted in burial-grounds, it would seem much more appropriate to associate the tree with pastoral scenes, wherein are pools or meadow brooks and with browsing cattle seeking the shade of its spreading branches. Frequently too it grows in city parks or other pleasure-grounds, and there its floating tresses over-shadow the walks and flower gardens. Hence the weeping willow, ever a tree of beauty and picturesqueness, seldom fails to make some definite impression on the mind of the most insensible observer.

PERSIMMON (Diospyros virginiana)

Essentially a southern tree of variable habit, the persimmon has outstanding characteristics that cause it to be well known wherever it occurs. While it averages rather small in size, being usually not more than 40 to 60 feet tall and with a trunk diameter that seldom exceeds a foot, occasionally forest-grown specimens may reach 70 or 100 feet and a diameter of two or three. Much depends on soil, climate and situation, for it is such factors which seem to influence not only its size but also its form of growth and vegetative vigor. Trees of both upright and drooping habit are met with throughout its range which extends from Connecticut to Florida and west to Kansas and Texas. Preferring plenty of suhlight, one usually finds the persimmon growing in abandoned fields, open woods, or along roadsides and fence-rows, most often as scattered individuals. In such situations it develops a short trunk surmounted by a broad, or occasionally narrow, round-topped crown of spreading often drooping branches. While able to exist on almost any type of soil, nevertheless it prefers fertile bottom-lands and there invariably will be found the largest individuals. Its ability to spread by means of root-suckers and thus to sometimes form dense thickets has caused the persimmon to be regarded as little more than a weed tree in some sections of the South.

Wherever it occurs, the persimmon has acquired a reputation for its fruit, so commonly associated in the popular mind with the southern negro and the opossum. Emerson and Weed, in their excellent book on "Our Trees and How to Know Them", explain this frequent association of the persimmon and the

opossum as follows: "Probably it is because the two species occupy somewhat similar positions in the dialect literature of the South, the persimmon fruits being as famous among trees in the folk-lore tales of the South as is the opossum among animals. At any rate, they are both extraordinary forms, being the sole representatives of their families in eastern America and occupying a very similar geographical range. Even their scientific names are not unlike, the persimmon being known technically as Diospyros virginiana, while the opossum is Didelphis virginiana". Because persimmons are the favorite food of this peculiar little animal it has given rise to the name "possum wood", by which the tree is known in various southern states.

The biblical phrase - "By their fruits ye shall know them" - applies particularly well to persimmon. Described and praised even by the early explorers, this tree has become popular for its fruits, with which most people are more or less familiar, either having seen them growing wild or else for sale in the public markets. Plum-like in appearance, but somewhat flattened as is a small tomato, each persimmon fruit becomes an inch or two broad and is borne on a short thick stem. It really is a large fleshy berry and hence like many other such fruits, the enlarged green calyx remains attached to it at the stem end; so also does the terminal style persist. Usually there are four to eight very hard, flat seeds contained within; though the number is variable, it tends to remain rather constant for each tree, and some varieties

are almost or entirely seedless. Some people consider persimmons as being "good for dogs, hogs and 'possums", while others class them among the choicest of wild fruits, for they can be utilized in various ways for preparing palatable food products. It is said that the southern negro regards the persimmon as "something good to run at" while they last.

Like choke cherries, one must know when to eat persimmons in order to appreciate their really delicious flavor. When green, or not thoroughly ripened, the tannin which they contain makes them harsh, bitter, and exceedingly astringent, so much so in fact that if eaten then they pucker the mouth, draw the lips, and choke the throat as would pebbles of alum. If fully ripe and soft, however, they become juicy and luscious, at which time they are yellow to pale orange-colored with a red cheek, often covered with a slight bluish bloom, and may be eaten with relish. They turn light brown after being frosted, which action too tends to ameliorate their austerity. Their flavor then is rich and sweet, somewhat like that of dates or dried apricots, while the flesh becomes pale and translucent. As persimmons differ in their size, shape, number of seeds, and coloring with almost every tree, so also does there appear to be a great variability in their time of ripening, as well as their relative food value.

Quite contrary to popular opinion, many fruits of excellent quality ripen and fall prior to autumn frosts; others must be subjected to a frost or two before becoming edible; but

then again, some of them, perhaps on adjoining trees, scarcely or never become fit to eat, no matter how severely or how often they are frosted. It is said that the largest as well as the best persimmons are those that ripen about the time the trees shed their leaves; most of the early varieties attain to medium size, whereas the later ones which hang on until cold weather generally are small. Some there are who claim that frost is detrimental to the quality of persimmons and partially destroys their flavor; but unquestionably the majority of people who profess familiarity with the tree, believe that they improve with age and hence that the longer they cling to the leafless branches the better they become. It would seem that wild fruit of such excellent quality might be greatly improved by careful selection and propagation, but thus far American plant breeders have accomplished very little in that direction. On the other hand, Japanese horticulturists, working for generations with their native species of persimmon, have been successful in developing countless varieties, some of which were introduced into California and the South and now are being cultivated there with success.

The bark constitutes another outstanding characteristic of persimmon. Its general appearance resembles rather closely that of black gum, for both trees have usually a mature bark that reminds one of an "alligator pattern". On old persimmon trees it becomes rough and deeply furrowed, with the ridges breaking up into coarse rectangular blocks, and showing

cinnamon-red at the bottom of the fissures. This thick, firm bark, of a dark gray-brown cast, covers the trunk like a protective coat of armor of distinctive and attractive appearance. The twigs are dark-colored, usually with a pale pubescence, and they contain a large pith; their tasts is bitter-astringent. There is no terminal bud, but the lateral ones are broadly ovate, acute, close-appressed, and covered with two dark glossy scales. One may readily identify the winter twigs of persimmon by their distinctive, semi-orbicular leaf scars, with one dark, crescent-shaped and depressed bundle scar contained within.

It is easy to confuse not only the bark but also the leaves of persimmon with those of black gum. Both have simple, alternate leaves of about the same size and shape, being thick, ovate, four to six inches long, two to three in width, and with entire margins. Their upper surfaces too appear dark green and glossy but, whereas those of black gum most often are smooth below, persimmon leaves usually remain more or less downy beneath. A positive means of distinction lies in the leaf-stalk, for that of persimmon contains only one vascular bundle and black gum has three. Also, of the two trees, persimmon alone bears no terminal buds and therefore a tiny twig projection extends beyond the base of its uppermost leaf petiole. While the leaves of black gum turn gorgeous red in autumn, those of the persimmon usually fall without much change of color.

Like the willows and poplars, the persimmon bears its staminate flowers on one tree and the pistillate on another.

Sometimes, though rarely, flowers occur which are perfect; that is, both stamens and pistils occupy the same flower; also, the two sexes may occasionally be found on separate branches of the same tree. While they look much alike, the male or pollen-bearing ones appear in small clusters, usually three flowers together, but the female or fruit-producing kinds are solitary. Both are waxlike, urn-shaped, four-parted, and their color varies from a greenish-yellow to a creamy-white. They are small, about a half-inch in length, short-stalked, and occur in May on branchlets of the current season's growth. Their fragrance attracts bees, and, being very light, the pollen is also distributed by the wind.

Persimmon belongs to the ebony family, Ebenaceae, some members of which show evidence of having existed in very early geological times. A few tropical species, of the same genus as persimmon, yield the valuable hard and close-grained wood of commerce known as ebony. Records show that man has prized this rare wood ever since the dawn of history, dating back to the time of the ancient Egyptians who made voyages far down the east African coast in order to secure it and, though ebony is an extremely hard wood, there is evidence to show that by some means or other it was then worked into furniture. But the wood of persimmon has never been so valued as is that of its tropical relatives. The tree does, however, produce enough heartwood and sapwood streaked with black to reveal its kinship. Possibly the climate in which it grows has something to do with its apparent inability to yield much heartwood, for persimmon makes

very slow growth and not until late in life does it form any heartwood at all. Hard, heavy and compact, its wood takes a fine polish, but little of it is sawed into lumber, though it is used to some small extent for specialized purposes. Most of it is made into shuttles for textile factories, for which use only two American woods, persimmon and dogwood, have been found to be satisfactory. Other uses include mallets, shoe lasts, billiard cues, golf club heads, brush backs, parquet flooring, and turnery. Persimmon has never been a wood of many uses nor is much of it sold on the market, hence the tree's chief interest lies in its fruit.

MEADOW SWEET (Spiraea salicifolia)

A smooth, slender and erect shrub, one to four feet high, is the meadow-sweet which frequents low moist ground and may be seen growing abundantly in old pasture meadows, swamps, and along roadside ditches. Rarely does this plant thrive in dry places, but it prefers to occupy instead the small tussocks and elevations rising out of wet soil. If given open sunlight and sufficient moisture it will spread by means of root suckers and thus often forms straggling thickets of variable extent. Each little bush is either simple or more often branched above, and has upright brittle stems of a polished coppery appearance. Its very fine twigs are usually of a lighter brown shade than is characteristic of the main stem, sometimes assuming even a grayish cast. They bear, in winter, numerous small buds of

alternate arrangement, each one of them acute and flattened closely to the twig. Found in this country from Newfouhdland to Georgia and west to the Rocky Mountains, meadow-sweet is not distinctively an American species, for it occurs also over a considerable portion of northern Europe and Siberia.

During July and August this very common and well-known plant decorates the low-lying meadows with its variegated masses of fleecy white plumes of delicate flowers. Its small and numerous florets crowd together in rounded bunches on the ends of the twigs, those at the summit of the stalk being so arranged as to form large, compound, pyramidal clusters. Some sturdy individuals also have flowering branches arising from the axils of their upper leaves; these further subdivide and each division likewise terminates in smaller auxilliary panicles of blossoms. The erect bloom is conspicuous, attracting one's attention not only to its beauty but also to a certain downy softness in its appearance. This peculiar "fuzzy" look results from the numerous protruding stamens with their thread-like filaments. Likewise, the anthers, being flesh-colored, impart to the flowers a faint rosy tint that is quite character-istic. Each tiny floret, usually not more than one-fourth of an inch across, is five-parted, perfect, and has rounded white petals. They blossom from the apex downward and before the lower ones in a cluster begin to open the upper have already faded. But the meadow-sweet is a very free bloomer, lasting from latter June till September, and often blending a few solitary flower

clusters with the tinted foliage of autumn. Despits its common and rather misleading name, the flowers of this plant are not sweet-scented, but they do secrete nectar which serves to attract great numbers of small bees, flies, beetles and other insects.

As if to enhance the attractiveness of its spiry floral plumes, the meadow-sweet bears too a profusion of simple, alternate and elegant leaves, extending down almost to the ground. Each of its upright stems is closely-set with smooth foliage of thin texture and having a pleasing yellow-green color. The individual leaves are from one to three inches long, broadly lance-shaped, pointed at both ends, and have margins that are singly or often doubly sharp-toothed, especially above the middle. While the uppermost ones are either short-stalked or sessile, those nearest the base have usually long petioles. Their autumnal tint varies from a pale yellow to a dull red.

Throughout the entire winter one may identify this plant by its conspicuous dry fruit pods which are quite characteristic. Each seed-vessel is formed of five smooth, one-seeded carpels, or follicles, united at the base and encircled by the persistent calyx-cup. Whereas most seed capsules of this type become inflated, those of the meadow-sweet seldom or never appear swollen. When fully mature they split open at the top in order to eject the several minute seeds contained within each tiny cell. Not infrequently do these empty pods cling to the branches so long that they appear among the flowers of the succeeding summer.

ALTERNATE-LEAVED DOGWOOD (Cornus alternifolia)

Sometimes rated as a small tree, but more frequently deserving only to be classed as a large shrub, six to twenty-five feet tall, this alternate-leaved dogwood may be distinguished easily by its peculiar habit of branching. Its shallow crown is flattened and widest near the top, with the slender branches coming off at right angles to the main stem and thus forming horizontally spreading tiers. Many of the short lateral twigs incline upward in a semi-circular fashion, a feature that probably is seen best when the leaves are off. In winter too its slender young shoots, of a glossy purplish-brown or occasionally dark green color, add to its charm and attractiveness. They bear small acute buds on which are two or three visible scales. The trunk and larger branches have a thin greenish or reddish-brown covering of bark, which on young trees appears smooth and streaked with gray, but later becomes shallowly furrowed and scaly.

No other species of dogwood bears habitually its leaves, twigs and buds in alternate arrangement. This is not, however, an infallible distinction, for the so-called alternate-leaved dogwood does occasionally show some leaves and other features that actually are opposite. Not only that, but its habit of crowding its leaves in clusters toward the tips of the branches, where they stand so close together as to seem whorled or opposite, often gives rise to some uncertainty as to

what their true status might in reality be. It requires close examination then to detect that, in the majority of cases where leaves appear to be opposite one another, the one really grows independently just below the other and not cojointly with it. But, while one occasionally meets with very confusing specimens, it more often happens that this dogwood's alternate form of branching is quite clearly discernible.

The leaves themselves resemble closely those of the flowering dogwood. They are oval or elliptical, two to four inches long, sharp-pointed, narrowed at the base, and have entire margins. Their upper surfaces become a smooth yellowish-green, but remain paler and slightly pubescent beneath. Borne on slender grooved petioles, an inch long or more, its leaves exhibit such a tufted arrangement, in flat sprays of foliage, as to be altogether distinctive. They have prominent sunken veins which curve upward to the leaf tip and parallel the margins, as is characteristic of all dogwoods. It is in autumn, however, that the foliage of this particular dogwood becomes especially attractive, for then it takes on a deep purplish-red color. In May or June the flowers appear, in rather loose, flat-topped terminal clusters or cymes, two to three inches across. The small individual florets composing each cluster vary from greenish-white to cream-colored. While its blossoms lack the conspicuous white bracts so characteristic of the flowering dogwood, their massed effect is such as to make a rather pretty showing. They are followed in early autumn by bluish-black

berries, about the size and shape of a pea, borne in loose, spreading, red-stemmed clusters. Each berry has a thin flesh which covers a rounded or somewhat flattened and grooved central pit. Though they are bitter, many kinds of birds feed on them so eagerly that often before October all are gone.

The alternate-leaved dogwood adapts itself to a great variety of situations, but prefers moist, well-drained soil, being found rather commonly along the borders of streams and swamps, or on fertile hillsides. Ranging from New Brunswick west to Minnesota and south to Florida and Alabama, it constitutes a fair proportion of the understory growth of open deciduous forests and is a familiar object throughout the mountainous sections of eastern United States.

(c) State Distribution of Forest Tree Seedlings - Planting, Care and Results.

Since ornamental nurseries have never made a serious attempt to grow and supply forest planting stock at prices low enough to encourage reforestation, this field has been assumed by many state forestry organizations. The trees are grown in state owned and operated nurseries, as a rule, and are distributed at cost or slightly less, under various regulations prescribing the planting and later care of the trees by the owner of the land whereon they are planted.

The United States government gives recognition to the importance of forest planting stock distribution in the Clark-McNary law, under which $95,000. was allotted to the several states in 1932 for cooperative use in growing trees for planting on private owned forest lands. This work has tremendous appeal and is a sort of entering wedge for forestry with many land owners. It also has educational value, and goes far toward impressing land owners with the value of good young natural forest growth. In 1932 thirty-nine states and two territories were growing forest trees for distribution to their citizens. Eleven of these states allotted all their trees to private planters, while the rest were doing some planting on public lands. The total expenditure for forest nursery work the country over in 1932 was about $750,000. More than a third of all this was spent in New York. Pennsylvania expended

$45,460. that year and allotted about half the stock produced for planting on smaller private projects.

The Pennsylvania Dept. of Forests and Waters operates four nurseries with a total area of 48.2 acres, producing approximately 10,000,000 trees annually for forest planting. This is sufficient to plant up less than 9,000 acres of land, and is ridiculously little when we recall that 92,000 acres of forests were burned over in the state in 1932 which was a rather favorable year as to weather and fire hazards. The Department of Welfare operated a large forest and ornamental nursery with prison labor at Rockview in Centre County. This nursery is limited by law so it can only grow stock for planting on public property. One large coal mining company also grows trees for its own use and for sale. The total area of forest reported as planted in the state in 1932 was 9,271 acres. There is surely a large field for expansion of forest planting in Penn's woods.

Trees distributed from the Pennsylvania State Forest nurseries are sold at $2.00 per thousand for seedlings and $5.00 per thousand for transplants. The land owners who plant these trees sign an agreement with the State that they will set and care for them according to instructions, will not plant them for shade or ornamental use, but rather for wood products, and will not dig or sell them later for such purposes,

nor will they be planted on land with a surface value of more than $100. per acre. These latter provisions are to protect commercial nurserymen who produce ornamental stock and fear that the trees distributed by the State may be used in competition with their business. Not less than 1,000 trees are sold to a planter, and fewer than 500 trees of any one kind will not be supplied.

Anyone desiring information on tree planting and distribution of planting stock can secure it free of charge by writing the Dept. of Forests and Waters at Harrisburg, or by getting in touch with the various district foresters and other local personnel (Circular 31 gives details and directions as well as a description of the trees available.)

Trees for forest planting are from one to five years old, - usually two or three, - but size is small and they can be shipped most anywhere in the state by express collect for $.80 to $1.25 per thousand on small orders, and even where large plantings are made. Orders should be placed a month or more before the date of planting, and it is best to do this six months in advance since planters who order early are less likely to be disappointed if certain kinds of stock become exhausted. Early spring is the best time for planting.

To date about 160,000 acres of land have been planted to forest in Pennsylvania. As a rule in most any locality where the soil is not too valuable for agriculture

or grazing, it is possible to find successful planted areas where the trees have been growing five years or longer and now begin to form a forest cover. The first private forest plantings in Pennsylvania on a considerable scale were made with trees bought from commercial ornamental nurseries or imported from Europe. On some of the latter stock the deadly white pine blister rust was brought into the country. In 1912 the State first sold a few trees to private planters, the project developed rapidly and to date (1933) private land owners have planted more than 110,000,000 trees in Pennsylvania.

(d) Questions.

(e) Field Trip. If possible, take a trip to some forest plantation ten years old or older, on which detailed history can be secured; such as age and size of stock, tools and methods used in planting, insect attacks or other calamities, character of land before planting, care or treatment given since, etc. Compare the appearance and thrift of trees in the plantation with that of similar aged stands and species in neighboring natural stands. Have all species planted been equally well adapted to the site and how do they compare in this respect to the native trees around the site? Take a mattock and dig up the soil so as to compare the effects of the different planted trees on the site as contrasted to (1)

a good natural stand, (2) grazed or pastured areas, (3) idle fields. Which areas will most rapidly and efficiently absorb water in case of heavy rainfall? Point out such special plantation pests as white pine weevil, pine tip moth, borers, aphids, pine and larch sawflies (or their work); deer damage, snow or wind breakage and deformation. Deterioration of the soil and erosion of lands once under cultivation usually put planted trees at a tremendous disadvantage; as is also true of fire where it has denuded an area and laid it open to sun, wind and driving storms; yet a well adapted species will grow remarkably well where protected from enemies.

Lesson 11. (a) Management of Forests, Purposes, Products, Rotations, Sub-divisions.

One of the greatest American foresters said the problem of forest management is "to build up, put in order, and keep in order a forest business".

There is no question but the forests of America generally and of Pennsylvania in particular need building up. By means of thoro protection followed by a wise use of the axe and mattock, the forest will be reconstructed. However, the definition places double emphasis on order, and it broaches the proposition that forestry is, or should be, a business. This signifies the harvesting and sale of goods, with a budget of expenditures that promise to yield profitable incomes. It includes bookkeeping balance sheets, inventories, wages, salaries, surveys, estimates, interest on loans and expenditures, taxation, profits, and economic or social satisfactions.

From its vast scope, we see at once that forest management is the brains and directing power presiding of forestry as a whole, hence must contact every branch of forest theory and practice.

To permit discussion and an understanding of the subject, forest management is logically subdivided as follows:

1. Mensuration or Measurement which begins with land surveys to determine the areas of forest as to ownership, types, age, stands and growing stock. In other words, surveys must

tell the forester how many acres of land of various classes he has on his forest to be managed. Then the wood volume or growing stock standing in the forest must be determined by kinds of trees, location, etc. This means that trees must be counted and measured up on a tremendous scale. For a very irregular object such as a tree, special methods must be used to measure it and calculate how many straight and square edged boards or timbers, and how many cords, or cubic feet of solid wood, can be cut therefrom. Mathematics of a very high and complex kind are used in forest mensuration, but in practice simple measurements, averages, and short-cut methods suffice to get the most needed facts.

To get the volume of a tree, it is usual to divide the bole or trunk and large limb into short sections 4 feet long, of which the average diameter is measured and volume worked out as for a cylinder. Then, of course, the total for volumes of all the sections gives the volume for the whole tree. Naturally, it is handy and easiest to measure the <u>diameter</u> of a tree at breast height (d.b.h.), 4½ feet above the base of the tree, so foresters take this as a standard point for measuring trees. If trees of a given kind are considered, and are fairly uniform in height, their volume will vary in proportion to diameter. Hence foresters have worked out <u>volume tables</u> based on the d.b.h. in inches and height of trees in feet. With such a table for red oak for example, it is only

IRREGULAR PAGINATION

necessary to measure trees at breast height and determine how tall they are, then take the table and read off how many cubic feet, or board feet, each one contains.

When volume tables have been carefully worked out for each kind of tree, or for satisfactory groups that grow with about the same form or taper of trunk, the forester can readily determine how much wood there is in a whole forest stand, (per acre) or for a given area on which tree diameters have been measured and heights determined.

It will be noticed that trees of a given species and diameter vary in height in keeping with the fertility and moisture available on the various sites; also more trees of a given size will be found on an acre where the soil is good than is the case where it is poor. In forestry therefore, lands are classified or subdivided into Site Quality I, II, III, IV, V, etc., depending upon their productivity, or ability to grow trees. On the basis of site quality classification for forest soils, foresters work out yield tables for the different important tree species.

Yield tables are expensive to compute and are built up from information gotten by measuring scores and even hundreds of sample plots in the forest under varying site conditions. They enable the forest management to foretell or forecast his yield. To illustrate: if a stand of white pine planted 15 years ago has its dominant trees 14 or 15 feet tall and there

are around 1500 trees per acre, the yield tables for white pine will show the area is Site Quality I for that tree, and consequently 60 years later it should show 226 trees per acre, averaging 95 feet tall and 15 inches in D.B.H. with a total wood yield of 12,500 cubic feet solid volume. Should the trees average only 12 feet tall, then the Site Quality is II and the expected yield in 60 years will be only 10,400 cubic feet of wood from trees of 13 inches D.B.H. and only 86 feet tall.

Of course, normal yield tables must be discounted if applied to an extensive forest area, since they are based on the growth of ideal stands with full stocking. It is, therefore, necessary to correct and check forest inventories made with yield tables by field measurementsand counts or stock surveys.

In this work it is usually impossible to cover 100% of a tract, since this would be very expensive. Hence strip surveys are used both along with yield tables and as a direct method of forest stock taking. The strips are laid out on the area in parallel lines, as a rule, with a width of 66 feet (1 chain) and spaced 660 feet apart (10 chains). This gives a ten percent inventory and is acceptably accurate for most purposes of forest management. (Show by sketch on chart or blackboard).

2. Forest Organization takes the facts and inventories of the forest, as found by the methods heretofore mentioned, and draws up on that basic forest working plans. These aim to secure and guarantee a continuous, and if possible, steady and increasing wood or money yield from the forest.

Forest Regulation is a synonymn for organization, and indicates that the use of the ax in the forest must be regulated and carefully controlled, or the ideal of continuous steady and increasing wood yields from a forest area can never be realized. Forest managers and owners change frequently. It is a trait of human nature to get as much income, or other return, as possible from a property. Therefore, where a forest property has no working plan, or cutting is unregulated, there is grave danger, in fact, almost a certainity, that more wood will be cut from the forest than is being replaced by growth. This means the forest growing stock will gradually dwindle away. Good forests will deteriorate into open, short boled tree stands, or mere brush land, as has occurred in Asia Minor, Greece, Italy, Spain, and a large part of China.

From the foregoing it is seen that a forest property needs surveys and inventories with growth studies to show how rapidly the various kinds of trees grow on the different sites, such as coves, lower slopes, upper slopes, and ridges; or on areas classified according to Site Quality. Not many foresters or woodland owners have the means or time to make reliable

studies for determining the growth rates of their trees under varying conditions. This is a part of the work of forest experiment and research stations under the government, as is also the problem of working out simple and accurate tree volume and forest yield tables.

Grwoth studies enable the forester to determine how many years will be required to grow trees big enough for the sawmill on various sites. Or if small posts, paper or fuel-wood, mine props, and the like, are desired, these studies show at what age the forest, or at what size the trees should be cut to get the greatest yield of the desired product. The period of years required to grow the forest crop is called a rotation.

To prevent cutting too much wood from a forest, a regulation is calculated by (1) area, (2) volume, or (3) a combination of area and volume.

To illustrate the simplest form of forest regulation of the cut (by area): If a State forest has an area of 25,000 acres, all mixt oaks, which will readily grow up again when cut off, and require 100 years (rotation) to grow into good saw log and railroad tie size, then each year the one hundredth part of the forest should be cut over, - which is 250 acres.

Of course, complications will arise. Markets are poor some years. Chestnut blight or forest fires may kill trees. Possibly very few or no areas are covered with trees large enough to be cut and marketed profitably. Thinnings and improvement

cuttings, or selection cutting may be desirable, and must be taken into consideration. Hence regulation by volume may be most suitable.

In the foregoing case, if the average yearly growth of mixt oak forest is 45 cubic feet of wood per acre, then the cut can be fixed or regulated at 45 x 25,000 or 315,000 cubic feet for the total forest. By keeping careful records of all cutting each year, the forest growing stock can be increased or reduced from time to time, as conditions seem to warrant. Of course, good records, a careful working plan, and occasional check inventories (stock surveys) on all or part of the forest, are needed to guarantee that forest production will go forward instead of retrograde.

In order to make it easier to manage a forest, and take or keep definite records thereon, a forest must be divided, - much as a farm is cut up into fields. The area units of management in forestry are called compartments. Where forestry is intensive and markets are good these units are small in area, possibly average 50 acres or less; and for temporary or special reasons may be broken up into sub-compartments whereon forest stands are uniform throughout. Where forestry is not well developed compartments of 1000 or more acres in area may be satisfactory.

3. Forestry Finance is concerned with calculations to secure and assure the highest possible money income from the forest considered in perpetuity. Among its complex problems are the

Valuation of stands of various ages and species, as well as entire forests; calculation of soil value under different methods of forestry; damage appraisals after fire, cutting or other calamity; and studies to test stumpage offers, taxation, insurance charges and the like.

(b) Tree and Shrub Identification. Broadleaf compound alternate leaved trees; walnuts; Shrubs - poison ivy, virginia creeper.

THE WALNUTS (Juglans sp.)

There are in the world about eleven known species of walnut, found chiefly in the north temperate zone. One occurs in South America and four others range from southeastern Europe to eastern Asia and Japan. Of the remaining six species, all native to North America, only two grow naturally in eastern United States, namely the black walnut and the butternut; another the English walnut, has been widely introduced. That walnuts existed far back in geological times is attested by the fact that numerous fossil species have been referred to the genus Juglans.

all members of this genus are deciduous trees, some of which attain large dimensions, usually with broad spreading crowns and furrowed bark. They thrive best in deep loamy soils and, not being social trees, most of them occur as scattered individuals throughout their respective ranges. All are useful nut and timber trees; also, due to their hardiness, they too have long been highly prized for ornamental purposes. Their bark is bitter and astringent, the sap aromatic; the inner bark becomes yellow on exposure to air. They yield a wood that is diffuse-porous, dark-colored, durable, easily worked and susceptible of receiving a beautiful polish; that of several species has become very valuable, particularly for cabinet-making and the

interior finish of houses. Being tap-rooted and therefore not easily transplanted after about two seasons of growth, much the simplest method of culture is to plant nuts instead of seedlings where the mature trees are to stand.

The walnuts have large, handsome, pinnately-compound leaves of alternate arrangement. They are made up of many serrate leaflets, comprising from five to eleven pairs arranged at intervals along the petiole, in the butternut, but the terminal ones are often absent in the black walnut. Their leaflets, as a general rule, may be described as ovate, with an acute or long-tapering tip, an unequal base, curved veins united near the margins, and, too, they are either sessile or short-stalked. When bruised they exhale an aromatic fragrance. The foliage, borne in tufts toward the ends of the branches, appears rather thin and never casts a dense shade. All species of walnut leaf - out late in spring and their yellowing foliage is shed early in autumn.

As the leaves are unfolding the flowers appear. Both pollen-bearing and seed-producing kinds occur on the same tree and usually on the same branch. The small and greenish staminate flowers are borne in drooping cylindrical catkins, three to five inches long or more; usually they appear sessile and solitary, on twigs of the previous year's growth. Each catkin consists of a pendulous chain of scales, and on the lower surface of every scale are borne many little stamen heads, from 8 to 40 in all, which contain the pollen. The fertile or pistillate

flowers occur singly or in small clusters at the ends of the branches. Wind serves as the principal pollenizing agent.

The walnuts are well-known for their typical fruit which ripens in one season and consists of a bony, sculptured nut surrounded by a thick, fibrous or pulpy husk. Of variable size and shape with different species, a walnut is either round or obscurely four-angled in cross-section and over its surface occurs a network of rough projections. Both the hard-shelled nut and in most instances, its spongy protective covering, are indehiscent; but, finally the husk is torn off or rots and then eventually the nut will, in decaying, separate into two valves. Inside the thick-walled and stony shell are two large seed-leaves, each so wrinkled and variously lobed as to bear a striking resemblance to the convolutions of the brain; they form the meat or kernel of the nut. As in the hickories, there exists a bony partition between the two halves of the kernel. Packed with starches and oils which sustain the young seedling, this kernel- really the seed - remains underground and within the shell during germination.

All species of walnut yield nuts of commercial importance which are gathered from both wild and cultivated trees. Nut culturists have produced a number of improved varieties and in some parts of the country, notably in California, the raising of English walnuts is an important industry. Not only is the walnut kernel sweet and delicately flavored but also it has such a concentrated food value as to make it wholesome and nutritious. These nuts contain an abundance of oil which, when

expressed, has been substituted occasionally for other more commonly used oils in painting and in cookery. Squirrels and other rodents feed on walnuts and thus aid in their dissemination. Many too are dispersed by gravity and floods. From the husks of the nuts has been produced a yellow dye material; formerly used to color homespun cloth; also, walnut bark may be used for tanning leather.

The twigs, buds and leaf-scars of the walnuts offer excellent distinguishing features. Their terminal buds are always the largest; generally they are unprotected, but sometimes are covered by two pairs of opposite scales. Usually from two to four superposed axillary buds stand grouped together, each one of them blunt, somewhat flattened, and with the uppermost the largest. They stand above prominent three-lobed leaf scars, in which are displayed three U-shaped clusters of small and dark-colored vascular bundle scars. Walnuts too have stout twigs which often are more or less fluted. But, when all other characteristics fail, members of this group may be known positively by the type of pith contained within their twigs. This central pith consists of thin horizontal plates separated by bread and angular air cells. No other trees have such chambered pith, excepting the hackberries and their features differ so markedly that they could newer be confused with the walnuts.

As already mentioned, two species of walnut are native

to eastern United States. They are the black walnut and the white walnut, the latter being more often known as butternut. Also, the English walnut is so commonly met with ~~everywhere~~ that it too will be described here. These three species may be separated by the following keys:

IN SUMMER

1. Leaflets 5 to 9, usually smooth and entire, with the terminal leaflet larger than the laterals; ripe husk separates from the thin-shelled and obscurely sculptured nut; kernel divided by a thin partition which splits readily..... English Walnut (J. regia)
1. Leaflets 11 to 25, downy and serrate, the terminal leaflet usually smaller than the laterals; ripe husk does not separate from the thick-shelled and deeply sculptured nut; kernel divided by a bony partition which does not split 2

2. Leaves and young twigs viscid-hairy; terminal leaflet usually present; fruit oblong, borne in short raceme-like clusters; husk clammy-pubescent; nut prominently ribbed, also 2-celled at base .. White Walnut or Butternut (J. cinerea)
2. Leaves and young twigs minutely downy; terminal leaflet usually absent or atrophied; fruit spherical, borne solitary or a few together; husk seldom pubescent, but roughly dotted; nut without sutural ribs, also 4-celled at top and bottom ..... Black Walnut (J. nigra)

IN WINTER

1. Leaf-scar with a downy pod along the convex upper margin; chambered pith dark brown; terminal bud usually elongated; bark gray, shallowly-furrowed, with broad, flat-topped ridges ..... Butternut (J. cinerea)
1. Leaf-scars without a fringe of hairs on their notched upper margins; chambered pith light to dark gray; terminal bud globular 2

2. Twigs densely gray-scurfy; bark on trunk dark brown and deeply furrowed, with narrow ridges enclosing somewhat diamond-shaped fissures .. Black Walnut (J. nigra)
2. Twigs smooth and reddish-brown; bark on trunk light gray, usually smooth but finally becoming deeply furrowed, with broad flat-topped ridges.. English Walnut (J. regia)

BLACK WALNUT (Juglans nigra)

When unbroken stands of virgin timber yet covered the fertile valleys of eastern United States, black walnut was, on the best sites, one of the giants of the forest. Thriving on the deep, rich, and well-drained soils of bottomlands, it there grew in company with such other trees as the ashes and hickories, some kinds of oak, tulip, elm, hackberry, beech and maple. In such situations, forest-grown black walnuts sometimes became as much as 150 feet tall, with a straight and massive trunk of magnificent proportions, and developed very little crown spread. Walnut of such size and form is now exceedingly rare; instead, one usually sees scattered field or roadside trees, of medium height, and having large and spreading branches. Occasionally, in farm woodlots or in fertile coves and hollows unsuited to agriculture, it does occur yet in mixture with other trees, though seldom doesit comprise more than a small fraction of the forest stand. Ranging from Massachusetts to Florida, and west to Ontario, Minnesota and Texas, black walnut has always been more abundant west than east of the Alleghany Mountains; there, too, it attains its largest proportions, especially in the Ohio and Mississippi River basins.

Occupying, as it did originally, the very best of agricultural areas, vast quantities of the finest black walnut served no better purpose than to be cut down and hewed into building timbers, split into fence posts and rails, or actually destroyed when land was being cleared in the pioneer days. Since then the wood has been so highly prized for cabinet making and furniture of all kinds that it has become quite scarce and its price has risen proportionately. Large amountsof it were formerly exported to foreign countries. Necessity soon demanded that solid walnut furniture should later give way to that made of walnut-veneered material; but, even today, its popularity has scarcely diminished, nor is it considered less fashionable than ever. So great is the demand for black walnut for various purposes that lumber dealers have scoured the country in order to buy up, singly and often at merely nominal rates, all trees of marketable size that could be secured. Many a sturdy monarch, whose spreading branches had for centuries graced the home premises or the rural landscape, has been finally sacrificed for a relatively small sum. Even the stumps are now grubbed out and cut into veneer. So also have black walnut timbers been removed from old buildingsor sought in rail fences that have withstood the test of time. Likewise, much of the solid furniture of a former generation has been dragged from seclusion and worked over. And still the demand continues, nor is it likely to cease so long as any merchantable material can be found.

Open-grown black walnut trees develop a broad, spacious head and have vigorous, wide-spreading branches. Their outline, as rugged and majestic as that of the oak, becomes with age quite characteristic. While the lower branches often are nearly horizontal, the upper ones arise at a sharper angle, thus forming an open, symmetrical, round-topped crown. Black walnut too may be known by its dark brown and deeply furrowed bark which, because of its narrow, rounded ridges and diamond-shaped fissures, resembles closely that of the white ash. When freshly broken, this rough outer bark has a rich chocolate-brown color, whereas the white inner layer soon becomes yellow after exposure.

The stout recent shoots of black walnut are densely gray-downy or powdery in summer, as are also the leaf stalks. By winter these same twigs have become rather smooth, of a grayish-brown cast, and, if chewed, their taste is bitter and it colors the saliva yellow. The buds too are dark gray and rounded, covered with thick, felt-like or satiny scales, and they stand above conspicuous three-lobed leaf-scars. On the upper margin of each leaf-scar occurs a notch, in which is enclosed one of the small, often superposed lateral buds. This tree differs from the butternut by having buds which are dark gray and nearly spherical instead of tan-colored and elongated, a gray rather than dark brown chambered pith, and particularly by its absence of a hairy fringe over the leaf-scar. Also, its darker bark, greater straightness of bole, and better general symmetry

should usually be sufficient, when leaves and fruit are absent, to distinguish black walnut from its near relative.

Its large, alternate, compound leaves are made up of from 11 to 25 almost sessile leaflets, each about three inches long and set in pairs along the downy petioles, making the whole leaf a foot or two in length. The individual leaflets have an ovate-lanceolate shape, are taper-pointed, irregularly toothed, bright yellow-green and smooth above, but somewhat paler and soft-pubescent beneath. Usually the odd terminal leaflet is absent, or, if present, it is long-stalked and appears to be atrophied. These truly handsome leaves, which become widest at the middle and with the upper and lower pairs of leaflets the shortest, turn a bright clear yellow, in early autumn, before they drop to the ground.

The stout, undivided, staminate catkins, 3 to 5 inches long, appear in May or June as the leaves unfold, at which time they droop from the one-year-old branchlets. On the ends of the same twigs occur the tiny female or pistillate flowers, in groups of three to five together; but, only one, or at most three of them, out of each cluster develop into nuts. The mature fruit is round to pear-shaped, from one to three inches in diameter, and has a thick fleshy rind enclosing a hard-shelled corrugated nut. Different improved varieties of walnut trees yield nuts that are of exceptional quality because of their larger size, finer flavor, and the greater ease with which the kernel is removed from the shell. Nevertheless, most of the walnut crop still comes from uncultivated and chiefly open-grown

trees. In rural districts the nuts are gathered for both home use and the local market.

It is just as much sport to gather walnuts as it is to go for hickory nuts or chestnuts. Those of country birth can recall many happy days spent harvesting walnuts and butternuts in the crisp atmosphere of Indian summer. They begin to ripen early in autumn and many cling to the branches long after the leaves have fallen. Their smooth or granulate rinds at first appear light green, later become more of a yellowish-green like the foliage, and eventually turn brown to almost black. When collecting walnuts, those on the trees are clubbed-off first and afterwards all are gathered together into piles. Then, using a stone for a hammer, the next job is to remove the soft husks from the nuts. Unless gloves are used, one's hands will become very much stained. A good rural recipe for removing the stain is to crush the leaves of a common low plant called sheep sorrel (Rumex acetosella) and then to rub its acid juices over the soiled skin. After the hulled walnuts have been taken home they should be spread out to dry; then placed in bags and hung in some dry place, such as the garret, until needed. They contain a sweet, rich-flavored and oily kernel which is used in cakes, salads, candies and other confectionery. It is said that black walnuts were an important food for the North American Indians.

Black walnut wood, because it possesses such a rare combination of desirable qualities, is highly prized, and valued possibly more than that of any other of our eastern

trees. It has a beautiful deep brown color, an endless variety of grain and figure, always takes a fine finish, and is easily worked or carved into the most artistic designs. Due to its beauty, strength and stability, walnut is known today, as it has been universally for centuries, as the ideal wood for the finest furniture and woodwork. The seasoned wood is of medium weight, shows little shrinkage, has good shock-resisting ability, and takes glue and finishes exceedingly well. For these reasons it ranks as a premier cabinet wood. Such excellent qualities, too, have made it especially suited for airplane propellers, gun stocks, and automobile steering wheels. Other select uses include sewing machines, musical instruments and coffins, as well as for panels and moldings in interior decoration.

Some highly figured black walnut, showing a great variety of fantastic patterns, comes from burl, crotch or stump wood which sometimes is so valuable that it sells by the pound. Only the dark-colored heartwood is merchantable; the pale sapwood has little durability. But, while this tree makes rapid growth on rich soils, it must attain to fairly large size before much heartwood is formed; hence, with age it becomes more valuable.

Black walnut requires, throughout its life, an abundance of light to develop properly. It has been planted extensively for its fruit, timber and shade. Many plantations are failures because the planting site does not have soil that is sufficiently deep, fertile or well-drained. For ornamental purposes this walnut should be planted where its litter is not objectionable

and where it has room to develop its wide-spreading crown. Also, its roots are believed to secrete some kind of a toxic substance-- that hinders or inhibits the growth of most other vegetation, excepting grass, existing beneath its canopy,

BUTTERNUT (Juglans cinerea)

A cousin of black walnut is the white walnut or butternut, another well-known nut-bearing tree of eastern United States. While its general range corresponds closely to that of black walnut, the butternut extends further northward, thrives at higher altitudes, and occasionally grows far up on the rocky slopes of mountains. It prefers, however, rich moist soil, hence it frequents the banks of cold mountain streams and also occurs commonly on fertile hillsides and limestone ridges, in open fields, and along fences and roads. In cool forested ravines and bottom-lands it associates with the beech, birches, maples, tulip, basswood and black gum, but with oaks and hickories on the uplands. It is distributed from New Brunswick to Georgia, and westward to Minnesota, Kansas and Arkansas.

Being a light-demanding tree, butternut appears to be most healthy and vigorous when growing in the open. There it develops a short trunk which divides into many wide-spreading branches to form a broad and symmetrical, round-topped but open crown of large limbs and stout, stiff branchlets. Usually it is a tree of medium size, rarely becoming more than 50 to 70 feet tall, unless crowded, and then only on the best sites has it been known to attain 100 feet. Forest-grown butternut frequently has,

in dense stands, a tall and spindling, crooked bole, surmounted by a small, shallow, and often lopsided crown. This tree, too, becomes defective, for its many dead and broken branches offer points of entrance for decay, hence it nearly always dies of disease rather than of old age. While young trees are very attractive, older specimens usually are scraggy and unsound.

Butternut has a characteristic gray bark by which it may be known at all seasons of the year, and which accounts for its Latin name "cinerea", meaning "ash-colored". On young trees this bark is comparatively smooth; but, on older trunks it becomes shallowly furrowed with wide, smooth and flat-topped ridges of a light gray color, separated by broader and darker fissures. The inner bark is bitter and becomes yellow on exposure to air; in former times much of it was used both medicinally and as a dye material. During the Civil War, it is said, many Confederate soldiers from mountainous sections wore homespun clothes dyed with butternut bark and then popularly known as "butternut jeans". At that time aniline dyes were yet unknown in this country. If butternut trees are tapped in the spring their sweet sap yields a fairly good quality of syrup, though it doesn't harden sufficiently to form sugar.

In summer the branchlets of butternut are of a gray-green color, very fuzzy and sticky, and have a clammy feel and a pungent odor. During winter, however, these stout young twigs appear orange-brown and are then rather smooth, but covered more or less thickly with small pale lenticels. If cut lengthwise

they show a dark brown chambered pith. The buds, like those of black walnut, have no protective scales; instead, they are densely pale downy. The terminal bud is about a half-inch long, angular or flattened, blunt-pointed, and contains both leaves and pistillate flowers. Its lateral buds are smaller and more rounded than the terminal; usually they occur in groups of two to four, one above the other, and with the uppermost the largest. Often these superposed lateral buds stand considerably above the prominent three-lobed leaf-scars, and, they too may be more or less stalked; one or two in each group look like little pineapple-shaped bodies or miniature cones, and it is they that contain the staminate catkins of next season. Along the convex upper margin of each leaf scar will be noticed a raised downy band or fringe of hairs, which has been likened to a beetling "eyebrow" or a close-trimmed "mustache". Thus, the winter twigs and buds of the butternut show many unusual features, while every structural detail supplies character and interest.

In size and shape, the large, alternate, compound leaves of butternut much resemble those of the black walnut. The principal differences are that its leaves usually show a sticky pubescence on both surfaces, but more densely below, and they also have well-developed and long-stalked terminal leaflets. They consist of from 10 to 24 sessile lateral leaflets, each about three inches long and one-half as broad, and set in pairs along the stout hairy petioles, making the whole leaf a foot or two in length. Each of the leaflets has an oblong-lanceolate

shape, is taper-pointed, rounded at the base, very finely shallow toothed, and appears yellow-green and wrinkled above, but pale and quite downy beneath. Its foliage, always thin and sparse appearing, comes out late in spring, and falls early in autumn; often by August it has become withered and shabby, at which time the tree commences to shed its leaves. So tender are these leaves of the butternut as to be unusually sensitive to both late spring and early autumn frosts; the first light frost in the fall brings them all down in a heap, sometimes even before the foliage of other surrounding trees has begun to turn color.

The stout, undivided, and cylindrical staminate catkins, 3 to 5 inches long, appear in May or June when the leaves are half-developed, at which time they droop from the one-year-old branchlets. The tiny fertile or pistillate flowers, on the contrary, come out on the shoots of the same spring, and are situated at their extremity; they occur in 2 to 6 flowered spikes, each flower about one-third of an inch long and without a stalk. Both kinds of flowers are greenish in color, and are borne on the same tree and usually near each other on the same branch. After the male catkins have shed their pollen they become brown, then wither and fall.

Whereas the fruit of black walnut is rounded and has a thick spongy husk, that of the butternut becomes more elongated and with a thin and somewhat leathery rind. They occur solitary or in short drooping clusters of two to five at the ends of the branches. Each fruit is ovoid to oblong in shape,

usually pointed at one end, about two inches in length and of half that thickness, while over its surface appears the same sticky fuzz which coats the leaves. These soft glandular hairs impart a characteristic "clammy" feel to both the foliage and the fruit of the butternut. The nut itself has four prominent and four other less conspicuous ridges or faint keel-like projections running lengthwise of its stony shell; it too becomes deeply sculptured between these narrow-sutural ribs, and thus is covered with rough and sharp corrugations. Its kernel consists of one piece, two-lobed at the base, which can with difficulty be extracted whole. The meat, being rich and oily, soon turns rancid unless the nuts are carefully dried and then it is sweet and pleasant-tasting; hence, doubtless, are derived the names of butternut and oilnut.

Throughout the summer the husk of the butternut is green, with a bitter yellow sap; but, after being frosted in autumn, it turns dark brown to black, at which time the fruit is ripe and can be gathered. It is said that the nuts, if taken while young and soft, make excellent pickles; first, however, the fuzz must be washed off with hot water, after which they are preserved in vinegar. From the husks, when boiled, can be made a yellow, orange or brownish dye, similar to that derived from the bark, and used formerly for coloring cloth, carpets and rugs. Ripe butternuts are truly delicious, even though difficult to crack, and despite their maximum of husk and shell for a minimum of kernel. Country people prize them and gather large quantities each fall, both for home use and for the local

market. They too are greatly relished by the squirrels whose activities account for the tree's wide distribution. To extract the kernel of a butternut or black walnut, the red squirrel knaws a large hole, shaped somewhat like an hour-glass, on opposite sides of the nut and always at right angles to its bony central partition.

Butternut produces a wood that is moderately light, soft, straight but coarse grained, easily split and worked, and it takes a good polish. It ranks as considerably lighter, weaker and less durable than is the wood of black walnut. Though its grain resembles closely that of black walnut it hasn't its rich chocolate color, the heartwood instead being a pale reddish brown which darkens somewhat with exposure. Most of it goes into furniture and interior finish. Other secondary uses include coffins, gun stocks, church altars, cooperage, boxes and crates, patterns in foundry work, woodenware and excelsior. Because of its scattered occurrence and usual small size, the wood of this tree has a varied though limited consumption, nor was it ever regarded as an important source of timber. Recently, however, the demand has been greater for butternut to imitate the popular imported English or Circassian walnut in furniture.

ENGLISH WALNUT (Juglans regia)

Of all the walnuts found in the world, this, undoubtedly, is the species best known, most widely distributed, and the highest esteemed for its nuts. It is this foreign tree which produces our delicious English walnuts, the Madeira nut of commerce, so commonly prized as a holiday luxury. It too yields the famous and expensive cabinet wood known on the market as Circassian walnut. Other names applied to it are European walnut, Persian walnut, and Italian, French, Austrian, Russian, and Turkish walnut, all of which refer either to countries to which it is native or else to places where it has been introduced and become commercially important.

This walnut grows wild about the Caucasus Mountains and the Black Sea in southeastern Europe, and from there eastward through Asia Minor, Persia, Afghanistan, and to India and the foothills of the Himalaya Mountains; also, some authorities claim that it crosses southern China to Japan. From earliest times, however, its range has been so extended by planting as to greatly confuse the original home of the tree. Pliny records that it was introduced into Italy from Persia, along with the peach and the apricot, and presumably more than a hundred years before the time of Christ. For many centuries this walnut has been cultivated in the Mediterranean region and in all portions of central and southern Europe having a mild climate. History shows that the Romans introduced it into England, but not in

quantity until about 1565 A.D.; hence, it is mentioned in the earliest of British botanical writings. There are no authentic records to show just when this tree was brought to the United States, but here it has been planted from the Atlantic to the Pacific. In the East it occurs more as a shade and ornamental tree which, because of its variable susceptibility to frost damage, can be grown successfully only in the warmer parts, though some hardy specimens exist as far north even as New Hampshire and southern Maine. In this country the commercial culture of English walnuts is confined chiefly to the Pacific Coast, particularly in southern California. It is said to have been first planted in California by the Mission fathers, but was not propagated extensively there until after 1850. Now the tree is cultivated in most temperate countries of the world.

This so-called English walnut matures into a handsome, wide-spreading, and round-headed tree, usually of intermediate size, and with a height of 40 to 70 feet. In its native range, however, particularly in the region northwest of the Himalayas, trees have been described as being 28 feet in circumference and from 100 to 120 feet tall. Planted trees develop a short, stout trunk which divides into many large limbs. English walnut too always has a characteristic silvery-gray bark which remains smooth for a long time. Some of the older specimens in the country have now reached several feet in diameter; the trunk bark then becomes darker-colored, thick, and deeply furrowed, but the

upper branches remain light gray and smooth, quite like those of the butternut. Its olive-gray to brownish twigs and dark-colored buds appear smooth and shining, nor is there any hairy fringe along the notched upper margin of its leaf-scars. The buds, short and rounded, usually have two to four opposite scales exposed; often the lateral ones are superposed, or accompanied by extra-axillary or accessory buds. Like black walnut, it has a gray chambered pith, but the pith diaphragms of an English walnut twig stand twice as far apart as do those of the black walnut.

The young leaves are bronze to reddish-brown in color; later on, when the foliage has become more developed, the green chlorophyl appears. When mature, they are smooth to glossy green above, borne alternately on long petioles, and consist of two, three, and sometimes four pairs of leaflets, surmounted by an odd terminal one. Each leaflet is oval in shape, pointed, two to four inches long, and entire or nearly so; usually the terminal leaflet is slightly larger than the laterals. When bruised they exhale a strong aromatic odor. This walnut, too, is densely foliaged and casts a dense shade. Its leaves turn a bright clear yellow in early autumn before falling.

Like those of the black walnut and butternut, the flowers of this foreign species appear before the unfolding of the leaves. The male catkins are sessile and pendant at the base of the young shoots; they too, are dense-flowered, greenish, cylindric, and become two to five inches long. The fertile ones,

in groups of two to three or more, terminate the current year's shoots; they are green, with purplish stigmas. Wind carries the pollen from tree to tree.

The fruit of the English walnut has been greatly improved by long and careful cultivation. In its natural state, where the trees generally have grown from the seed, the fruit contains a small hard-shelled nut. Now there are many commercial varieties, all varying in their degree of hardihood, time of ripening, thickness and sculpturing of the nut shell, as well as size, shape, flavour, and other particulars. Usually the fruit is round to oval, and covered with a smooth fleshy husk which, when ripe, becomes brittle and breaks open irregularly to release the nut; the husks adhere temporarily to the twigs, while the nuts drop clean-shelled to the ground. The rind is green with glandular dots, finally turning black; its resinous and astringent properties have caused it to be used medicinally, as well as for dyeing purposes. The nut itself averages about an inch and a half in diameter; it is more or less wrinkled, but not nearly so rough as that of black walnut or butternut. Some of the better improved varieties yield nuts with a shell that is only obscurely sculptured, and so thin as to be easily crushed by the fingers. The kernel has a very agreeable taste; it is large, four-lobed, and readily removed, in halves or sometimes whole, from the shell. It is claimed that soon after its maturity an English walnut has the best flavour and is then easiest to digest; later, after the oily principle has formed,

they become oppressive, if taken immoderately. In European countries much oil of fine quality is extracted from the seeds by pressure; it is used for drying oils in paints and in printing ink. There too, particularly in England, many of the young walnuts are used for pickling.

Since walnut, like other nut trees, seldom breeds true from seed, but tends instead to degenerate in reproduction, it becomes necessary to propagate each variety vegetatively. On our Pacific Coast the English walnut usually is grafted or budded to a seedling rootstock of the California black walnut (J. californica). Top-grafting too is commonly practiced. Grafted trees yield fruit at from six to ten years of age; they reach full-bearing when twenty years old and continue to be productive for thirty years or more. For commercial production the trees are planted in groves; usually they are set at thirty foot intervals in rows spaced sixty feet apart. When ripe, the nuts are picked, dried, graded into sizes, and the brown shells bleached to give them the tint demanded by the market. Many of them have undesirable appearing shells; these, as well as the loose-shelled nuts, are usually cracked; the meats removed, and all moldy, shrivelled and rancid kernels eliminated. Whole walnuts generally are shipped in bags holding about 100 pounds.

The chief climatic limitations of this walnut are frosts in spring and fall; though fairly hardy when dormant, it is very tender when growing. It also cannot endure extremely

hot weather. A deep, well-drained, silt-loam soil, containing an abundance of organic matter, and free from hardpan, sandy subsoil, or alkali, is another essential for a first-class walnut grove. Usually irrigation becomes necessary in most California walnut districts. Thus it will be noted that successful production demands unusually favorable situations. Formerly the culture of English walnuts was confined to four of the southeastern coast counties of California; but, in more recent years, the industry has spread to other parts of that State and to Oregon. In some sections of California, the walnut industry occupies a place second only to the growing of citrous fruits. Western production in 1927 was officially estimated at 47 thousand tons of nuts, with a total net value to the growers of more than sixteen million dollars. During the same year there were imported, principally from the Mediterranean region, almost 28 thousand tons additional; however, these importations will probably cease when all young orchards, now planted on the Pacific Coast, come into full bearing.

The wood, known on the lumber market as Circassian walnut, resembles in structure that of our eastern black walnut, but is of much lighter color. Its heartwood is fawn-colored, marked with numerous dark brown or black streaks, and is noted for its charming figure and velvety texture. Old trees, particularly those bearing small and thick-shelled nuts, yield

the best wood, whereas the most beautifully veined material comes from burls, roots and stumps. It ranks as one of the most attractive and valuable of veneer woods, with the best grades often commanding a higher price even than mahogany. But long before mahogany became known in Europe, this walnut was prized as their best wood for cabinet work and interior finish. One of the earliest examples of furniture now in existence, dating back to the early Middle Ages, is the walnut coffer, the forerunner of the cupboard. Other examples of the work of early European designers and craftsmen include handsome chests of solid Circassian walnut, huge stately chairs with beautifully carved perpendicular backs, and the sideboard or "borgia" with its wonderful inlay work and elaborate carving and embellishment. So also the artistic genius of famous English master designers such as Chippendale, Heppelwhite and Sheraton, serves only to reflect the basic superiority of this walnut as a cabinet wood. However, foreign countries later employed it almost exclusively for gun stocks, and their frequent wars made heavy inroads on the available supply. Prior to the World War, much of this wood was utilized in the United States; now its excessive cost limits its use to only the very finest furniture and cabinet work. Often it is employed here in combination with red gum; but, of all our native woods, butternut offers the best and most satisfactory substitute for Circassian walnut. It is said that the principal world supply of this wood now comes from the regions bordering on the Black Sea; also, from Circassia, a Russian district there, it is believed to have derived its common name.

Two woody vines which often are confused will be discussed next. They are the poison ivy and the Virginia creeper. Both occur commonly, on much the same sites, and over a wide range in eastern United States. Whereas the one is deservedly avoided and despised by most people, the other is entirely harmless and ranks as one of our most beautiful ornamental vines. It is so easy to distinguish between them that every person should be able to do so.

VIRGINIA CREEPER (Psedera quinquefolia)

This high-climbing or trailing vine, known also as woodbine, American ivy or five-leaved ivy, is often feared as something poisonous. In reality, it is entirely harmless. Only in their habit of growth do it and the poison ivy really resemble each other. It might be well to remember that the five leaflets of Virginia creeper suggest somewhat the fingers of one's hand, whereas our poison ivy has but three leaflets. There too exist many other differences between them. The smooth, often glossy leaves of the poison ivy, with their entire margins, contrast sharply with the dull green and coarsely toothed leaves of this plant. One should beware of the white berries of poison ivy, and also of poison sumach, but the dark blue ones on the creeper may be handled with impunity. In winter the poison ivy has gray twigs with prominent lenticels, stalked acute buds, and crescent-shaped leaf-scars; the other has brown twigs, small blunt buds, and

sunken bowl-shaped leaf-scars. The above distinctions should serve to differentiate them at all seasons of the year.

Virginia creeper is probably the most vigorous and hardy of our native vines. One sees it everywhere covering trees, fences and walls, often to a distance of fifty feet or more. Few rustic lanes there are where it is not seen creeping over the fences and mingling its glowing autumnal tints with those of other wayside plants. It thrives in open sunlight; for, though it is not uncommon in the deep forest, it grows feebly in shade and hence its thick stem is deficient of leaves until it gains the summits of the trees. Often it is seen clothing old decaying buildings or forming natural festoons from tree to tree, and many an old stone wall is completely enveloped in its foliage. Its rapidity of growth and the luxuriance and beauty of its foliage have caused it to be extensively planted and trained to cover porches, trellises, and the sides of buildings.

Like the English ivy (Hedera helix), so commonly seen in cultivation, it produces adhesive disk-tipped tendrils which enable it to cling firmly to the sides of brick or stone buildings, walls and cliffs. These tendrils stand opposite the leaves and shoots; each is divided into 5 to 12 branches, and with the branch tips either twining or ending in sucker-like disks. The vine is further supported by aerial rootlets, springing from the stems. Because of its wide range, which extends from New Hampshire to Minnesota and south to Florida

and Texas, the Virginia creeper apparently exhibits s ufficient variation of clinging habits to justify its separation into two species and two other varieties. Though thriving in almost any soil, it most commonly grows wild in low, rich but well-drained ground. It may be propagated by seed, hard wood cuttings and layering.

Its leaves are alternate, long-petioled, and palmately compound. Normally the leaflets are five in number, though they vary sometimes from three to seven; all radiate from a center, quite like the compound leaf of the horse-chestnut. Each of its leaflets has usually an obovate outline, with a wedge-shaped base and short tapering apex; their margins are coarsely toothed above the middle, but entire toward the base. Always the two lateral leaflets are much smaller than the others, and with the middle one a trifle the largest. Its leaves, too, regularly diminish in size down to the small folded ones near the curving tip of the vine. In October they become brilliantly colored, with rich shades of scarlet, crimson and purple, making it one of the most conspicuous ornaments of the autumnal months.

During June and July its panicles of small greenish flowers attract many bees. They develop into loose forking clusters of dark blue berries, covered with a bloom and borne on bright red stems. The berries, about the size of buckshot, are scarcely fleshy and contain from one to four seeds1 They mature in autumn, at which time many birds feed on them and scatter the seeds far and wide.

POISON IVY (Rhus toxicodendron)

Few of our poisonous plants are better known or more deservedly shunned and despised than is the common poison ivy. For centuries botanists, plant physiologists and others have been attempting to solve its secret and to evolve a really effective cure for those afflicted. Still the old adage - "an ounce of prevention is worth a pound of cure" - holds special significance in regard to poison ivy. Much the wisest policy is first to learn how to recognize the plant and then to steer clear of it always.

This woody species has two habits of growth, the one trailing or climbing and the other erect. The running form, much the more common, is what is popularly known as poison ivy. The other, or bushy form, sometimes gets the confusing name of poison oak. Some authorities regard them as two separate and distinct species. More recent studies, however, suggest that the low erect forms consist of shoots or branches from underground stems. Most often it climbs in great profusion over walls and fences and up the trunks of trees. Though it firmly attaches itself by numerous threadlike aerial rootlets, poison ivy derives no nourishment from the living trees or bushes over which it clambers; nevertheless, its host often is smothered or bent over from the enveloping weight. Its stem may reach from one to three inches in thickness and extend to fifty feet or more; if cut open, it exudes a milky juice which soon turns black upon exposure to the air. One may look for poison ivy almost anywhere, in moist

or dry situations, in open sunlight or partial shade, and thruout the vast territory from Nova Scotia to British Columbia and South to Florida, Arkansas and Utah.

Unquestionably the best way to distinguish poison ivy is by means of its compound, alternate leaves, made up of three leaflets. They have a peculiar dark green color, and usually appear glossy as tho waxed. While the two lateral leaflets are nearly sessile, the terminal one is stalked. In size, shape and texture, they show considerable variation. Usually, however, each leaflet is broadly ovate, mostly pointed, and with an entire or coarsely toothed and lobed margin. In autumn the foliage of poison ivy assumes a brilliant coloration yellow to orange and red.

About June its minute greenish flowers appear in loose axillary clusters. The fruit ripens in autumn and consists of gray berries, much like those of the poison sumach. These small one-seeded drupes cling until late in the winter, forming a food for some birds which disseminate the plant. In winter too it may be known by its gray twigs, covered with many prominent lenticels, also, its stalked and naked buds and crescent-shaped leaf-scars offer other helpful features.

Formerly it was thought that poison ivy secreted a volatile oil which permeated the surrounding air, much as does the perfume arising from sweet-scented foliage or flowers. Hence people believed that merely being near the plant or having the wind blow this supposed mist or the pollen over them would result in ivy poisoning. Only recently have scientists determined

that this poisonous substance consists really of a non-volatile oil, called toxidendrol, which cannot be transmitted unless one's skin comes in actual contact with the plant. Quite often, tho, people are unwittingly poisoned by handling shoes or clothing that previously have touched or rubbed against the leaves. While some individuals are much more susceptible than others, many are absolutely immune; also, with age, one apparently develops a stronger resistance to ivy poisoning. Those with fair skin, particularly blondes, seem most susceptible, while the majority of persons contract it easiest when perspiring freely.

The symptoms of ivy poisoning are inflammation and violent itching, followed by raised watery blisters which usually last from a week to ten days. At first this eruption appears only where the skin has come in contact with the poison; later, however, it may spread to other or all parts of the body. So far as is known, only humans are affected, for all the lower animals apparently may brush against the plant or even browse over it with impunity. Fortunately, poison ivy doesn't affect the mucous membranes, hence it cannot be contracted internally. Indeed, people have been known to eat some of its leaves each spring of the year, which practice is claimed to result in immunity to further attacks (better not try this).

There are many recorded antidotes for ivy poison, none of which seem very effective, once it has broken out or become widespread. This varies, though, with different people,

and what will help in some cases will not in others. The writer, who is very susceptible to this poisoning, has, after trying most of the supposed remedies, come to the conclusion that only after running its natural course, and usually despite all medicines applied, does the eruption finally subside. Generally thatinvolves from a week to ten days of patient endurance and misery. Proper treatment will, however, prevent it from spreading rapidly. As soon as possible, after one has gotten into poison ivy or even suspects that he has, the affected parts should be washed thoroughly with alcohol, gasoline, or common soap and water; next to shunning the plant, this probably is the best advice that can be given. Most doctors prescribe a concentrated solution of lead acetate (sugar of lead). Among other specifics commonly used are sodium bicarbonate (baking soda), mercurichrome, copper sulpate (blue vitriol), potassium permanganate, and even strong salt water. Usually their principal benefit is to stimulate the morale of the patient rather than to actually affect a cure. Some of them, if applied too frequently or in very strong solution, will kill the skin or even cause sores to develop. Patience alone proves to be the one attribute that is indispensible.

(c) Wood Identification.

Classes of Woods:-

(1) Non-porous
(2) Ring Porous
(3) Diffuse Porous.

Anyone who has bought furniture, worked with wood, or had their attention called to the beauty of wood figures in panels or elsewhere, knows that this common substance shows tremendous variation in color, grain, texture, strength, weight, and composition. In all wood working industries, it is a prime requisite that workmen know the common woods at a glance, and understand enough of their chief characteristics to work and use them to best advantage.

Woods are most commonly studied and identified by their appearance in cross-section, or when cut as smoothly as possible across at a right angle to the axis of the trunk or branch.

Numerous features of wood aid in its identification and classification, and influence its uses. All these features are more or less interrelated and determine the ease of working, hardness, color, figure and strength of wood under different conditions and in various positions.

Wood in the tree undergoes certain changes and is not all alike. It forms in layers over the whole living body of the tree. Each year a thin layer of new wood is added.

When a tree trunk, branch, or piece of wood is cut across, these thin layers of wood are seen as concentric rings, or as more or less parallel bands when a small piece from a large tree is studied. Wood consists of living cells at first, varying greatly in shape, size, and service to the tree. The contents of the microscopic cells are gelatinous when they form, but soon harden or shrink, so that all wood is dead to every intent and purpose, though it stores the digested food substances in the tree and is an important conducting medium thru which the sap solutions circulate.

In looking at a tree stump or other cross-section of wood, it is often seen that the central part is darker in color than the outside portion. The outer and paler colored part of a tree cross-section is called sapwood, while the central dark portion is the heartwood. The wood cells in the heartwood are either entirely filled up with ligium and resins, or else their walls are very much thickened by deposits of these inert materials. The heartwood of trees is more durable, harder, and heavier than the sapwood as a rule, but so far as the tree is concerned it serves only mechanical functions; giving support and rigidity, and possibly storing some food in the tree.

In the annual ring not all wood is alike in texture. The part nearest the center of the tree, which is formed in spring, and hence called spring-wood, is not so

dense or strong as that on the outer edge of the ring, which is formed during the hot months of summer and hence called summer-wood.

(1) Non-porous Woods are more even and honeycomb like in structure than are the porous hardwoods. They also uniformly show indistinct or very fine medullary rays.

Medullary rays are the fine nearly straight lines which are seen in a wood cross section, running from the bark in toward, or to the center of the tree. They are composed of rather simple cells serving to store food materials, and conduct sap solutions in a horizontal direction, especially.

The conifers or needle-leaf trees have non-porous wood. They are commonly also called soft-wood trees, while the porous wood species (broadleaf trees) are called hardwoods. While this classification is literally true in most cases, there are exceptions however. For instance, the wood of pitch pine or longleaf pine is far harder than that of aspen or basswood, yet the latter are both hardwoods in this classification.

Porous woods have long, but fine to microscopic tubes, or vessels which carry the sap up from the roots to the twigs and leaves. These pores can be seen with the naked eye as a rule, and appear as round, fine to minute holes, or pits, when the wood is studied in cross-section.

In the non-porous woods no special vessels or tubes

(Note: A number of cross sections of common trees should be available for inspection and study.)

occur in the wood for conducting the sap to the leaves and twig tips. Instead it passes from cell to cell thru valve-like openings in their walls. However, in some of these coniferous woods there are resin ducts which carry oily resins that are secreted, or manufactured, by special cells. These ducts appear as greasy dots or very fine openings in a wood cross section, so they may be mistaken for pores, altho they are never so numerous as the latter would be.

A good magnifying glass or hand lens is very helpful when studying woods. A good sharp pocket knife that will cut a smooth surface is also needed.

(2) Ring Porous Woods have numerous relatively large vessels or tubes in the spring wood part of their annual rings. (See oak, chestnut or ash).

(3) Diffuse Porous Woods have vessels or tubes of variable but usually fine size, scattered more or less uniformly thruout the whole of the annual rings.

Resin Ducts are present in the following four important non-porous woods:

(1) Spruce has no distinct heartwood and is rather uniform and white when a new cut cross-section is examined. Resin ducts very small and not numerous. Wood rather soft and relatively weak. As a rule, fine in grain or texture and easy to work.

(2) Douglas Fir has distinct orange reddish heartwood, sapwood pale yellowish much as in the hard pines. Resin ducts not numerous nor even in distribution, often combined in groups of 8 to 30 so as to make resinous lines on the cross section. Wood strong, hard, and coarse splintery; rather variable depending on whether trees have grown slowly or rapidly and hence show fine or coarse grain.

(3) Larch or Tamarack has pale rusty brown heartwood and thin yellowish brown sapwood. Resin ducts very few and irregularly scattered. Wood variable but mostly hard, heavy, durable, irregular in grain and growth, strong, tending to be coarse. Eastern larch is largely used for poles and piling. It is usually met in small sizes and is not very resinous. Western U.S. larch occurs in large sizes and is often very resinous.

(4) Pine shows a distinct heartwood region and has numerous resin ducts scattered evenly thru the annual rings.

A. Wood of the Soft Pines (Eastern U.S. White Pine and the 5-needle pines of the West and the Old World) shows a gradual transition in the annual rings between the spring wood and summer wood portions; color white to yellowish red. Wood is soft, light, weak, and easy to work. It is the "whittlers' delight".

B. The Hard Pines (two and three needle pines) have annual rings with broad bands of dense dark colored summer wood showing a more or less abrupt transition to the spring wood on the side toward the centre of the cross section. Color variable but mostly darker than in the soft pines. Woods vary from very hard, heavy, and strong (long leaf pine) to soft or brittle (red, Scotch, and scrub pines). Generally harder and heavier than the soft pines, and far more difficult to work.

(Note: Pieces of crating, shipping boxes, the wood used in doors or windows, and siding or house frames and rafters, should be investigated and studied by the instructor and students. This adds a practical touch to the course, and should uncover good material to illustrate the lesson. Wood from green trees can be cut and studied, but it is often not typical.)

(d) Questions.

(e) Field Trip. A trip to the woods where trees have been cut, may permit the students to measure up some trees in sections, and calculate their cubic foot contents. If there are any permanent sample plots maintained in the vicinity, visit one or more of these; explain how it is used to determine the growth rate of the forest.

For wood identification, a trip can be taken out around the camp. Wherever miscellaneous wood can be found it can be studied, - poles, fence posts, shingles, railroad ties, etc.

LESSON 12. (a) Government Costs and Taxes. Forest Taxes.

Before taking up forest taxation a brief review of the different government units, their services, and tax costs will aid in the background picture of taxation. The taxing units are (in order from the top down) the United States Government; Pennsylvania (or other state); the individual County; the Local Government (city, borough or township) and the local School Board. Some states have no local township and school board units but stop with the county which, with them, is the lowest government unit.

NATIONAL GOVERNMENT

The United States or national government has a very simple constitution of 8 to 9 pages. Its preamble states the reason for having a national government and for the resulting taxes to support it. It reads "We the people of the United States, in order to form a more perfect Union, establish Justice, insure domestic Tranquility, provide for the common defense, promote the general Welfare, and secure the blessings of Liberty to ourselves and our Posterity, do ordain and establish this Constitution for the United States of America".*

It should be noted that the preamble is largely concerned with the establishing of justice, insuring domestic tranquility, and providing for the common defense. So also the enumerated powers of Congress in Section 8 emphasize national protection, through the maintaining of an Army, Navy, and the use

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* Capitalization and punctuation of original, which went into effect in 1789.

of the militia to execute the laws, suppress insurrections and repel invasions. This item of national protection is the first and most important function of the national government. To find fault with the nation for spending a preponderant part of its income on this function is like censuring a School Board for spending most of its tax income on the public schools. This aspect is overlooked by many intemperate critics of our National Government.

Other functions of the National Government named specifically in the constitution, include the regulation of commerce; control of naturalization; bankruptcy supervision; control of money and its value; fixing standards of weights and measures; establishing the postal system; controlling patents and copyrights; and regulating the territory and property of the United States. Many national governmental activities have been added to the above under the constitutional authority for promoting the general welfare, and the contribution to the functions enumerated in the constitution. These include for example, assistance to agriculture (including agricultural experiment and suppression of crop pests), regulation of railroads, river and harbor improvement, assistance in the building of post roads, canal construction, and among a multitude of minor items the maintenance and purchase of national forests. For 1930 less than 60% of the federal expenditures (war bond interest included) may be classified as "protection" and over 40% as civil activities (social welfare, highways, education, public utilities and

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general government expenses). The "protection" expenditure has never been below 50% of the federal government income, and of course rises in war and post war periods.

If the "land bounties" paid soldiers of our early wars were entered in the calculation of protection costs of those periods, it could be stated that the percentage of federal tax money spent for protection shows a slight tendency to decrease. When the present expenditures are summarized, the radical reduction in pensions and army expenditures and the increased agricultural and economic expenditures of the "New Deal" program, will reduce the protection item of national expenditures relatively further than ever before.

The national government in 1928 spent about 31% of all government expenditures; the states 15% and the local governments 54%; or as totals -

	Total (Million dollars)	Per Capita (dollars)
National Government *	3,973	32
State Governments	1,837	15
Local Governments	6,813	56
TOTAL	12,623	103

While the total taxes spent by the different branches of government have greatly increased from 1890 to 1929, our pop-

* American Public Finance and Taxation by Shultz; Prentice-Hall, N.Y., 1931.

ulation and national income have also increased. It has been calculated that taxes, national, state, county and local, took 7.2% of our national income in 1890 and 11.6% in 1929. Considering the greatly improved living conditions and government services, such as improved roads - better public schools; the reduced costs of government regulated public utility services; the reduced costs of many commodities made possible by public works such as the Panama Canal, river and harbor improvements, etc., the control of agricultural pests and plant diseases; the development of more productive strains of crop plants and animal breeds; the increase of game and recreation in public forests and a multitude of other benefits; the increase of our governmental expenditure from 1890 to 1929 appears largely justifiable. It is only when national income shrinks sharply, as from 1930 to 1933, that governmental expenditures and taxes, falling slower than national income, become an acute problem.

How does the national government secure its tax income? In 1910 96% came from duties on foreign imports, plus liquor and tobacco taxes. Since the great war these have had to be supplemented by income taxes. So in 1930 the national government income came* from:-

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* P. 231 - American Public Finance and Taxation - Shultz.

Subject	Percent of Total Income
Import duties	16
Liquors and tobacco	12
Personal incomes	32
Corporation incomes	35
Inheritance taxes	2
Other commodity taxes	3
	100

With the fall in personal and corporation income taxes in 1930-33 the national government has had to add a beer tax, a small gasoline tax, increased postage, and numerous other minor taxes to try to balance its budget. It should be noted that the national government has no property tax and a relatively small inheritance tax, with a rebate where states also have an inheritance tax.

Pennsylvania (and other states) spend most of their tax income on public school assistance; roads; and public welfare, hospitals, homes, and penal institutions. These disbursements in Pennsylvania for the 1929-31 biennium were approximately:-

	Million dollars	Approx. Percentage
Dept. Public Instruction (Schools, Colleges, including buildings by Property & Supplies),	90	25
Dept. Welfare (Hospitals and Institutions, including buildings by Property & Supplies),	42	11
Dept. Highways - Motor Fund disrubsement (includes 9 million gas tax to counties),	155	42
Other expenditures (exclude retirement funds),	82	22
Total expenditures,	369	100

Highways, schools and welfare institutions are seen to take 78% of the state expenditures.

The approximate Pennsylvania State tax income for the 1929-31 biennium was:

		Million dollars	Approx. Percentage
(1)	Taxes on corporation stock, loans, insurance and utility gross receipts tax,	91	25
(2)	Inheritance taxes,	65	18
(3)	Mercantile license taxes,	8	2
(4)	Motor Fund (Vehicle licenses & gasoline tax mostly),	142	39
(5)	Other income (includes 10 million dollars State Workmens insurance fund; and over 3 million dollars fish and game licenses; and 11 million federal aid- non-tax income),	57	16
Total income* (excludes retirment and sinking funds)		363	100

* Excluding 35 million employe payments and bond redemptions in retirement funds.

Business, inheritance and motor vehicle and gasoline taxes are seen to make up 84% of the state income. The latter two are applied to highway building and maintenance. There are no state taxes on real estate in Pennsylvania. Deducting non-tax revenues there remains 170 million dollars per year or $18. per capita for 1931.

The next taxing body is the County. It does some road and bridge building, looks after the poor (almshouse and home relief) with state and federal aid; finds funds for the operation of the local courts, and cooperates in the expense of mothers pensions, farm agent work, etc. The county must defray the expense of its citizens in state hospitals and penal institutions.

The County Commissioners lay a tax on:

(1) All county real estate (valuos fixed by local township and borough assessors), except public utility property paying a state gross receipts tax and a capital stock tax.

(2) On "occupation values" (nominal generally).

(3) 4 mills per dollar on securities, money at interest and mortgages, not taxed by state.

The county tax is levied at a stated number of mills (fixed by the Co. Commissioners annually) per dollar real estate value. Different assessors assess at different percentages of property sale value. With the fall in farm and forest land values and the rise in town values, farm and forest land pays the

county tax generally on a higher assessed value (in relation to sale value) than town property. This results in shifting an undue part of the county tax burden onto the farm and forest owner. For example in Franklin County, Penna., in 1926 to 1931, farms were assessed at about 68% of their sale value, while town residence and business property was assessed at only about 40% of sale value. This unequal assessment forced the farmers to pay a county tax of 5.4 mills on their property sale value, while the town people paid only 3.2 mills on the sale value of their property. A single trained assessor for the entire county is recommended by the last State Tax Commission as the solution for this inequality.

The total county tax for all counties in Penna. in 1928 was over 52 million dollars or over $5. per capita.

The cities, boroughs and townships must keep up streets and local roads (not state or county roads), street lights, sewers, fire protection and police protection, (Municipal water, gas, or light services are not included as taxes). In 1928 these services cost 155 million dollars in Pennsylvania, of which 111 million was city tax. These taxes are raised largely from the real estate tax, with minor income from occupation taxes, and in some cities a head tax in place of an occupation tax.

The last taxing body is the School Board. The public school taxes in Penna. in 1928 were 145 million dollars or $15. per capita. About one third the cost of the schools is included in the state tax above. School boards tax real estate and levy a head tax not to exceed $5. per head of population.

PENNSYLVANIA TAX SUMMARY

National Taxes	$32.	per capita
State taxes	18.	" "
County taxes	5.	" "
School taxes	15.	" "
City, Boro., Twp., taxes	16.	" "
TOTAL	$86.	" "

(all for 1928 except state which is for fiscal year 1930-31).

This summary indicates Pennsylvania tax payers carry a tax burden about $17. less per capita than the national average - due to lower local taxes. Such a total is somewhat misleading, however, because the average citizen pays no U.S. income tax, nor state tax except through reduced dividends, and in motor fund taxes (all for roads). If he owns no real estate he pays little local tax except through higher rents. It is safe to say the average wage worker and salaried or professional man who is below the income tax brackets gets off with relatively light indirect taxes. The security owner pays a little more. But the real estate owner has to bear the burden of the county, city, borough, township and school taxes.

It was pointed out that taxes took 11.6 percent of the national income in 1929. The farmer pays the maximum real property tax and in 1925* he was paying 13.6% of his income in

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* The Rural Tax Problem in Penna. - F.P. Weaver - Bul. 263- Penna. State College.

taxes while non-farm people paid 9.5%. This disparity has been increased in the years 1929-33 since the farm incomes have fallen relatively further than others.

Forest Taxation

In the preceding discussion it was pointed out that real estate pays county, township, (borough or city) and school taxes and that these local taxes, which from the bulk of all taxes, bear heavier on real estate incomes than any other. Lower town assessments throw a portion of the towns share of the county tax on the farm and forest. The forest forms from almost 0 up to 19 percent (Potter Co.) of the total county real estate taxable value in the different counties of Pennsylvania. In many townships of forested counties the forest land forms 60 to 69 percent of the total taxable value. Tax rates in these forest counties are high, so that unless the assessed value is made low on forest land the per acre tax required of the owner each year may more than equal the value of the timber growth. Authentic records of merchantable timber land taxes of from $1.00 to $7.40 per acre and year have been noted in Pennsylvania. Such taxes are confiscating the property. The owner had better cut the timber and invest in government bonds which are tax free and often pay more interest than timber land.

Forest land matures its crop but once in 30 years for mine timbers and only in 60 to 100 years for saw logs. This

means that 30 to 100 taxes are paid by the succession of owners before each timber crop is marketed.

If the forest land tax averages only 10 cents an acre a year the taxes in 60 years compounded at 6 percent would amount to $53. This would absorb a large part of the gross value of a 60 year timber crop on that acre, and might take all the profit if the timber stand were not heavy, or had received considerable fire injury.

Forest land may be bought with partly grown timber already on it. This reduces the number of taxes that the last owner must pay before he can mature his timber for market and increases the chance of a reasonable profit.

In order to enable an owner to hold forest lands over the long periods necessary, the state has provided that the forest land may be classified as "auxiliary state forest", and assessed at not over $1.00 per acre. This land then pays an annual tax of 3 to 7 cents per acre depending on the local tax rates, and the owner pays in addition 10% of the stumpage value of the timber when cut. This law keeps high annual forest taxes from confiscating the value of the wood crop, when the owner has his forest land so classified. The state pays 4 cents an acre each year to the local government for each acre so classified to help meet expenses until the timber is cut and the additional 10% is paid.

Because of the long time investment and mounting costs of growing timber, a large part of our more mountainous

forest land should be owned and controlled by the government. It can figure costs at 3 to 4% interest and pays low taxes (or payments in lieu of taxes). The State pays 5 cents per acre each year to the local governments on our State forests in lieu of taxes. The National Government pays no annual sum but pays 25% of all forest income to the local government in lieu of taxes. This system enables large scale reforestation to take place, and in the long run the local cummunities are much better off with these lands in the hand of the government. They are better protected, made more accessible (by good roads) for public hunting, fishing, and recreation, and will produce more timber and restore local industries, as well as protect streams, power dams, and water supplies.

LESSON 12 (b) Tree and Shrub Identification: Broadleaf Compound Alternate-leaved Trees; Hickories and Mountain Ash - Shrubs - Blackberries, Dewberries, and Raspberries.

HICKORIES (Carya sp.)

The walnut family (Juglandaceae) in America is represented even more notably by the hickory trees, shellbarks, and pecan than by the walnuts (Juglans), tho these too are nobler and more important here than anywhere else in the world. Down to now 20 different species of Carya have been described by botanists in North America and Mexico east of the Rocky Mtns., while one recently discovered member of the genus in China is all the rest of the world can boast. The sturdy hickory has been designated the "athlete of the forest" because its supple strength defies every storm. They might also be honored as the "100% American" trees, since nowhere else in the world have they any standing in commerce or practical forestry. In honor of its patron saint, General Andrew Jackson (Old Hickory), the Democratic Party in the U.S. long ago adopted the hickory tree as its emblem and prototype. Their opponents have sometimes remarked that the adoption was most appropriate because these trees are the "toughest" in the world. Ten or twelve of the U.S. hickories are common enough to merit attention from foresters and landowners. Five species occur native in Penna., and the pecan has been quite extensively introduced and propagated by nut lovers. These species are included in the key below given. All are notably deep tap-rooters.

The hickory genus is like the walnuts in a general way but it is distinguished by the following details:

(1) Flower stalks are branched. (2) Gentral pith is continuous and not septate. (3) Nuts have 4-valved, more or less dehiscent husks. (4) Wood is notably hard, tough, elastic, and strong, but non-durable when exposed to the weather The hickory handle in an American axe, and the use of this wood in many U.S. machine parts, tools, and vehicles, have aided greatly in rendering American made articles of the sort the world's standard of excellence.

Some of the hickory species yield nuts of unsurpassed flavor, while others have small bitter kernels entirely unsuited to human consumption.

KEY TO HICKORIES OF PENNA.- NATIVE AND NATURALIZED

1. Buds with valvate scales; leaflets usually 9 or more... 2
1. Bud scales overlapping; " " 5 or 7 3

2. Buds yellow glandular, terminal ones flattened like walnut; leaflets average 9 .... Bitternut (C.cordiformis)
2. Buds bright brown with yellow hairs; leaflets 9-17; nuts sweetest and best in genus -Pecan (C. illinoensis)

3. Nuts with 1/2 dehiscent husks; twigs relatively fine and hairless; leaflets average 5, smooth-Pignut (C.glabra)
3. Husks split to base of nuts; twigs heavy and more or less hairy as a rule; leaflets 5 or 7 4

4. Nuts with thick shells and small kernels; buds globose or nearly so; bark tight and ridged; twigs and leaves more or less downy .....Mockernut (C. alba)
4. Nuts thin-shelled, or very large, with sweet kernels, buds ovoid; bark shed or shelled off in long hard plates.. 5

5. Leaflets average 5; buds with outer scales acute and nearly smooth,inner ones obtuse,velvety,-Shellbark (C. ovata)
5. Leaflets average 7; buds with evenly downy scales; nuts often very large; twigs heavy -Big Shellbark (C.lacinios

PIGNUT HICKORY (Carya glabra)

From the standpoint of forestry in Penna. this hickory deserves to lead the genus and should be favored wherever found. It will thrive on poorer and drier soil than other hickories and is most able to reproduce itself by virtue of large and frequent crops of small nuts which are very attractive to squirrels and secure for themselves thereby a wide dispersal. Hickory wood is not all equal in quality. That of pecan and bitternur is not so strong, heavy, or elastic as the wood of our other Penna. species. That of pignut is the peer of any.

The common name of this tree denotes that its nuts are usually too small or lacking in flavor to serve for human food, and hence were allotted to the swine. However, the pear-shaped fruits vary greatly from tree to tree. Most of the nuts leave an astringent after-taste when eaten. Occasional trees yield good edible nuts.

The rather fine twigs of this tree aid in its identification in winter. They are very tough and withe-like. In pioneer days they were cut, tied together in bundles and then beaten or whipped around a post so as to make a fairly satisfactory broom, from whence the tree is still locally called "broom hickory". Grows to 90 feet tall and 3 or 4 feet in diameter sometimes on favorable sites. Bark is fairly tight but may be shed in narrow strips on old trees.

MOCKERNUT or WHITE HICKORY (C, alba)

Like the pignut hickory, this tree is relatively modest and occurs on sites of medium to mediocre quality, seeming to prefer warm slopes and well drained uplands. Its tight and hard ridged bark is typical along with sparse and heavy twigs which give the crown a stiff aspect. The trees average 7 leaflets with downy petioles. There is a stronger oily fragrance about this tree than any other in the group.

The names accepted refer to the large fruits borne in contrast to their woefully small kernels enclosed in a shell almost as hard as bone; while the Latin for the thick white sapwood which is characteristic and probably the best in the genus by a narrow margin. The tree grows as large or larger than the pignut.

SHELLBARK HICKORY (C. ovata)

Shagbark is another name for this tree and is an apt description of its bole appearance. It is the best species of the genus native in Penna. in quality of nuts, and size attained; sometimes growing 120 feet tall and 3 or 4 feet in diameter.

The shellbark is more exacting as to soil and climate than are the pignut and mockernut hickories, but is nevertheless able to thrive on ordinary sites where late frosts in spring do not tend to recur. Lower hill slopes and well-

drained stream-banks are ideal habitats, where it associates with maples, basswood, Elm, and our more exacting oaks, and may become 120 feet tall and 3 feet in diameter as a maximum. Wood of this tree is slightly heavier than that of the other Carya species and ranks with the best.

BIG SHELLBARK (C. laciniosa)

"King nut" is a local name which emphasizes the large size of fruit borne by this tree. However, size is not the best test of quality, and the preceding tree is generally superior to this one as to form and flavor of kernels. However, both trees deserve and have recently received the earnest attention of plant improvers and tree breeders. Individual of the big shellbark show considerable variation as to thickness of nut shells, and presence or absence or a corky covering on the kernels which usually contains tannin and spoils the flavor of the nuts. Nuts are notably flattened and acute at both ends as a rule. The leaflets average 7 and the main petiole often persists for years on vigorous young saplings. This feature is met occasionally in C. ovata but never in other species. The two shellbarks are alike in form and size attained, but C. laciniosa is coarser in all its parts.

All the hickories discussed heretofore are ranked by foresters as light demanding trees, however, their seedlings and saplings endure fairly heavy shade for years especially

where the site is satisfactory. It therefore often happens that when a stand of good oak is cut down, msny straight and vigorous hickory trees almost immediately appear and may dominate the new stand, altho under the old oaks no trees of these sorts were present except small cripples and crooks that almost escaped the eye. Young hickory trees should be favored wherever they occur, and since they are transplanted with difficulty should be propagated by planting nuts wherever suitable soils are available. Fence lines in agricultural localities are a good place to grow these trees as their deep-going roots do not interfere with cultivation or compete with the shallow rooting farm crops for moisture and fertility.

The hickory bark beetle (Scolytus quadrispinosus) and the bark borer (Cyllene pictus) are serious enemies of the genus Carya. They rarely or never injure thrifty trees, but are bad where drought or defoliation has weakened trees. If hickories are noticed to be showing yellow leaves and dying branch tips in July or August, and on inspection fine sawdust is found in the bark crevices of the trunk, then one or both the above pests may be suspected. If they are present in any considerable numbers, the trees may as well be cut and burned for fuel during the next autumn and winter, - or at least the bark should be burned, - otherwise increasing broods of the insects may endanger all the hickories in the locality.

The hickories of Penna. are primarily associated species of the mixt oak forest type, but the big shellbark and bitternut are frequently met in the forest type known as the

"river and swamp hardwoods," with its variants found along the creeks draining the agricultural valleys of the state.

BITTERNUT HICKORY (C. cordiformis)

This tree, the big shellbark, and the pecan are nearly similar in soil demands. All three require a good deep soil with adequate moisture for vigorous development. For this reason the bitternut had better be replaced by its better brethern wherever man can bring this about, since wood as well as nuts are inferior to some extent. The nuts of bitternut are decidedly thin shelled and are borne in profusion. They can be cracked by pressing two together in the hand. If some observant tree lover can find a tree with sweet kernels, it should be easy to develop therefrom a "paper-shell" variety of hickory nut. Hogs and squirrels eat the nuts at present, but prefer other food. Swamp hickory is a name that this tree gets sometimes because it often occurs along streams and swamp margins.

Twigs are medium fine, smooth, and with angular brownish pith. Leaflets are lanceolate acute. Bark is tight with flat narrow ridges. Nuts are enclosed in a 1/2-dehiscent thin husk.

Bitternut is a handsome tree, well suited for shade purposes. Both it and pecan look more like vigorous walnuts rather than hickory trees.

PECAN (C. illionensis)

This tree has its natural range from central Texas to central Alabama, north to central Oklahoma and Kentucky, thence to northwestern Illinois. However, since the nuts have won a well deserved reputation, the tree is now found cultivated all over the temperate world. It is indeed a hickory that has traveled and has had the "advantage" of horticultural education. In some southern localities pecan orchards are a major industry. However, it is often said there, that they are frequently of greater value as bait for "northern suckers" than as nut producers. This is true because the pecan is exacting as to site, and when planted on poor "pine land" can never hope to succeed. Good varieties of hardy pecans are available for planting in Penna., but they , as well as good walnuts and shellbarks, must be propagated by budding or grafting. The seedling trees are nearly always disappointing.

This is one of the large forest trees of eastern North America. Specimens 160 to 170 feet tall and 5 or 6 feet in diameter are recorded. Wood is lighter than for other trees of this group and not quite so good, altho it is tough and flexible, makes excellent fuel, and is often used for the same purposes as that of other Carya species.

Two large pecan trees on the lawn at Mt. Vernon,

planted by the Father of our Country, are among the worth-while things to note when a visit is made to that national shrine dear to the heart of every American.

AMERICAN MOUNTAIN ASH (Pyrus americana)

This small tree or large shrub has been a bone of contention to botanists. By some it is put into a separate genus (Sorbus) of the rose family (Rosaceae), while others emphasize its similarity in flower and fruit structure to the larger apples and pears, and hence group them all together. The common name ash is a misnomer, since the tree has nothing in common with that group except odd-pinnately compound leaves, and these are alternately arranged, so it would be more fitting to call the tree a walnut, or hickory. But mountain ash it is and will remain, because our ancestors in Europe gave that designation to a very similar tree (Pyrus aucuparia), the rowan (Eberesche or Vogelbeere,- German.

The small flowers of this tree are borne in large terminal umbels rather like those of the elderberry or wild carrot. The fruits are somewhat larger than elderberries but resemble them in arrangements on the stalks. Fruit is bright red and very attractive in winter, as it clings far along into the melancholy season of the year and adds its note of beauty and cheer. Birds eat the berries undoubtedly, but they do not seem to prefer them, and

possibly too the frosts of winter may ameliorate their acidity and stringency somewhat.

Twigs of mtn. ash are fairly stout, smooth, gray to red-brown, with a large brownish pith; buds purple-red, sharp, glossy-gummy, - terminal ones much larger than laterals and often with curved tips. Lateral buds are close appressed. Leaves usually have about 15 leaflets.

This is a tree of our cooler mountains in Pa. and there it clings to moist slopes, edges of swamps or knolls therein, and stream banks. Sometimes it grows to a foot in diameter and 30 feet or more tall, but is usually much smaller.

Beauty and bird food are the chief merits of our mtn. ash. However, it is in no sense a forest weed, as it is rarely a common species, and casts such a light shade as to be a desirable shelter and nurse tree for seedlings of forestry importance. Tho the species may occur in nearly any sort of forest association as an accidental tree because of seed distribution by birds, it is, however, really a member of the northern swamp forest type along with red spruce, balsam fir, tamarack, high bush blueberry, and mtn. holly. Both this tree and its European cousin are well beloved ornamentals.

THE BRIARS OR BRAMBLES (Rubus sp.)

All this genus of the rose family are thorny, prickly, or bristly shrubs with stems scarcely deserving to be called woody and having a large central pith region. Their

fruit is an aggregate of fleshy juicy drupelets containing a small more or less flattened seed. The stems are usually biennial from perennial root-systems. The six common species native in Pa. ar distinguished in the below brief key:-

KEY TO BERRY BRIERS OF PENNA.

1. Stems prostrate or creeping 2
1. Stems nearly or quite upright in growth habit 3

2. Leaflets smooth, glossy green, tough, sub-evergreen; stems fine, more or less weak-prickly... Swamp Dewberry (R. hispidus)
2. Coarser and rougher than preceding; armed with recurved thorns; leaves deciduous... Dewberry (R. villosus)

3. Stems angular, stout thorny; leaves palmate compound; flowers large, white; fruit inseparable from its core .....Blackberry (R. allegheniensis)
3. Stems round in cross section, weak thorny or prickly; leaves pinnately compound or simple; ripe fruit separates from its core 4

4. Leaves simple; stems unarmed, glandular-hairy; flowers pink to purple .....Purple Flowering Raspberry (R. odoratus)
4. Leaves compound; stems prickly; flowers whitish 5

5. Stems yellow brown, hispid-bristly; fruit red, Wild Raspberry (R. idaeus var.)
5. Stems reddish glaucous with hooked prickles on stalks and petioles; fruit black (or brownish) Black Raspberry (R. occidentalis)

SWAMP DEWBERRY (Rubus hispidus) is a very insignificant shrub found crawling about in swamps among the sphagnum moss, and on other acid sites where the soil is moist.

COMMON DEWBERRY (R. villosus)

This trailing brier is also an indicator of acid soils. While the swamp dewberry yields but a few small berries with but several drupelets, this one produces nearly globose fruits almost, or quite, as big as blackberries.

BLACKBERRY (R. allegheniensis) needs no introduction to anyone who has planted trees or worked long in the forests of Pa. Its strong thorns and vigorous growth on moist soils where the sun has access sometimes make forestry work miserable. This brier is also an acid soil index, but will thrive wherever it finds suitable sunlight and moisture.

BLACK RASPBERRY (R. occidentalis) is a glaucous-stemmed brier that grows with a characteristic curve so its tip takes root. It is common on soils but slightly acid or neutral. Yields a highly desirable and pleasant fruit, the black-cap raspberry of commerce. A number of superior varieties of both this and the preceding berry have been developed and are important in horticulture.

WILD RED RASPBERRY (R. idaeus variety) is not so vigorous in growth, but more upright in habit than the black raspberry. It is also more a species of cool slopes and banks in acid forest soils, while the black species is at home along farm fence rows.

PURPLE FLOWERING RASPBERRY (R. odoratus) is one of the most beautiful woody plants of the forests of Pa. Its delicately fragrant wild rose type flowers and refreshing red fruits are unsurpassed for beauty and interest in our forests. It is virtually a rose without a thorn which in addition affords the world a delicious but little known fruit. Rocky, cool, moist banks, or lower slopes are the habitats where this pleasant shrub is met. Its simple leaves and the absence of thorns or prickles put it in a class by itself. In some localities it goes by the name thimble-berry.

(c) Wood Identification - Conifers (completed)

Non-porous Woods Without Resin Ducts

The woods in this group never show vertical resin-ducts unless as a result of injury. In general, they are lighter in weight than the woods of the species with resin ducts. The following important trees have wood belonging to this class.

(1) Fir or Balsam has no distinct heartwood, color yellowish white with the summer wood part of the annual rings darker yellowish. Wood usually soft, light, weak and inferior for most uses, altho it works rather easily, and as better woods become scarce, has been found satisfactory for many purposes where strength or hardness are not required and it is protected from the weather.

The red fir and one or two other species of the West are the best in this group. They grow to large size and have fairly hard wood with a yellow brown color tinged reddish. Balsam fir represents this group in the eastern U.S. and finds its chief use mixt with spruce as pulpwood for newsprint paper.

(2) Hemlock has no distinct heartwood, is reddish or rosy tinted, has disagreeable odor noticeable in new cut moist or green pieces. Wood is splintery and harsh, good for rough construction and framing of buildings, light in proportion to its strength; has very hard knots; splits easily especially

along the annual rings. When the wood is split this way in standing trees due to stress from wind, it is known as ring shake, and is quite common in large hemlock trees, rendering many of little value for lumber so far as the butt section or log is concerned.

(3) Red Cedar or Juniper has purplish to brownish red heartwood and yellowish white sapwood. Wood is medium hard to soft, light, fine grained, and aromatic. Because of extreme durability and fair strength red cedar is often used for posts, fence rails, small poles, and rustic construction.

(4) Redwood has heartwood varying in color from maroon to terra cotta or deep red brown; sapwood pale orange to dark yellow brown. Wood is very soft, light in weight and odorless; not strong but very durable. Medullary (pith) rays are more pronounced in redwood than other conifers and are easily seen in a radial section (quarter sawed cut). Resin masses or globules of dark color are sometimes found in wood sections. This wood is much used for shingles, posts, weather-boarding, and for other purposes where durability is the prime requisite.

(5) Bald Cypress has heartwood but it is only a shade darker in color than the sapwood, being a dirty yellowish brown to nearly black at times; odorless and tasteless as a rule, the sometimes a rancid aroma is noticeable in keeping with the greasy or waxy look and feel of newly cut wood sections.

Annual rings usually narrow but wood often varying greatly in this respect, as well as strength, weight, and hardness; since these features are evidently dependent on growth conditions of the tree. Wood is durable and serves about the same purposes as redwood; in addition being used for interior finish and in planing mill work. It well merits its trade name "the wood eternal". The texture of wood is variable, as it may be splintery and coarse, or soft, fine grained, and easy to work.

(6) White Cedars (Chamaecyparis and Thuya species) have heartwood but slightly darker in color than the sapwood; noticeably resinous odor. Some western species have wood with a spicy-resinous taste, but this feature is absent in the eastern trees of the group. Wood fine, soft, durable, pale yellowish to brownish, light in weight, easily worked, not very strong; has uses about the same as redwood, red cedar, and cypress, in addition to being excellent for poles and piling.

(7) Incense Cedar has wood like the preceding group, but its odor is very pronounced and highly typical. Fresh cut wood has a peppery taste.

This tree of the West grows large and yields wood of fine and even texture which is primarily used for shingles, and such other uses where durability is important.

(d) Questions. Attempt to correlate the species discussed in Lesson 11 and 12 with their growing conditions, and make sure that men associate the woods with the trees that yield them.

This is important as regards the hard pines and cedars.

(e) Field Trip. A field trip should be taken to some planing mill, if not too distant. Otherwise it may be well to have instead 10 or 12 numbered pieces of wood which can be passed about as a test during the question period; asking each man to make a guess at the correct name of each piece. Wood about camp warehouses and tool sheds, or secured from crates and boxes in some country store, will often show a considerable variety of material.

LESSON 13 (a) Idle Lands; Delinquent Tax Lands.

Pennsylvania was once an almost unbroken forest. The settlers cleared the forest for the farm crops required to support themselves, their cattle and produce enough additional crops to sell for the purchase of the few things not supplied by the farm. Gradually the cleared land was extended on the best soils, but much individual poor judgment was used in clearing steep and poor gravel and shale hill and mountain lands. After homes were once built, the abandonment of these low producing soils was difficult. Many of these mountain and hill farmers had winter work in the lumber camps which helped them earn a living. Finally the timber was all cut, the lumber towns went out, and local markets and supplementary work came to an end together. With this, rich western soils came under the plow which produced wheat at less cost than eastern hill and mountain farms. Our foreign markets for wheat and meat fell off, due to agricultural expansion in new countries like Canada, Argentine, and Australia. Then horses and mules were supplanted on the roads and in the fields by automobiles, trucks and tractors, reducing the need for millions of acres of farm land used for growing horse feed - hay, oats and corn. All these contributed to the low price of farm products.

Naturally the poorer farms no longer yielded a living and they have been abandoned wholesale in parts of

Pennsylvania. From 1900 to 1930 the farms decreased over 4 million acres in total area, and 3.6 million acres in improved (cleared) land. This loss in improved farm land is equal to about 38% of the remaining improved land in farms.

Many of the farms have been completely abandoned, the owner or tenant finding work in the industrial plants of the cities. Often only the poorest part of the farm has been dropped from the crop and pasture class, and allowed to run to weeds, brush and scrub trees.

This large scale development of idle farm lands set in when the lumber cut began to fail, along with the destruction of our remaining forests by ax and fire. Land abandonment and deforestation have gone on hand in hand since.

Taxes have remained relatively higher on these lands - whether cleared, or cut over and burned forest lands, than on town property and the more productive farm land. With little income in sight these lands have been sold for taxes in increasing quantities. A canvass of most of the counties of the state revealed about four tenths of a million acres of cleared land sold to the counties, or advertised for sale, and another seven tenths of a million of forest land, making over a million acres defaulting in taxes. Of this a half million acres were "sold to the counties" for want of private bidders. This "no mans land" has no service except to grow timber. Although the state has been buying denuded forest lands by fits and starts for reforestation, it has made no

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effort to acquire and reforest the abandoned farm lands as New York has done. In self protection the state must acquire additional large areas of mountain land struggling back to forest growth, and definitely include in its purchase and reforestation program provision for the abandoned farm lands as well.

These abandoned farm lands are easy to reforest and are heavy producers of timber. Our second growth natural stands include much less pine and hemlock than our original forests contained. Planting these idle farm lands to conifers - pines, spruce, hemlock, larch and fir, will furnish much needed wood for paper pulp, general building lumber, match stock, poles, and many other forest products needed by our industries, farms and home builders.

The products from these lands will again contribute a goodly sum to the tax chests, and furnish a field for labor - both in the forest, and wood using plants, and railroads as well. Mill-run lumber selling for $20. to $30. per thousand feet in Pennsylvania should pay the timber grower $5. to $8. per thousand on the stump, the logger and mill man $8. to $10. for cutting the trees and manufacturing the lumber, and the truck or railroad transportation $5. to $8. per thousand feet and the seller $2. to $4. per thousand. That means a yearly distribution of $10. to $15. each acre reforested as old farm lands will produce 1 cord or 500 bd. ft. per acre and year.

The reason the state must handle the reforestation of these idle lands is that nurseries must be developed or increased in their seedling output to supply plant material for a large reforestation project. This takes 2 to 3 years. Then it takes young trees about 30 years to grow to mine timber and pulp size, 40 to 60 years to grow to pole and tie size; and 40 to 80 or more years to grow to saw-timber size. The government will go on century after century. It must plan far into the future. This lies beyond the average individual to carry through. Where corporation and individuals, as mining and water companies, and farmers, will carry the otherwise idle land along with their other operations anyway, reforestation is entirely practicable for them. It will increase the value of the property as soon as the young trees are established, even though the timber yields are far in the future.

When the general public becomes forest minded, and learns to discount closely and reliably the value of future timber crops to any present immature stage, the owner of idle land can reforest it and hold it for say ten years, and then sell it to another investor for its increased value, who in turn will hold it and sell on further to another investor receiving again an increased value, until the final owner finds the timber mature and cuts it to liquidate the long continued investment. Such investments made by informed investors go on earning interest whether there are business panics or not.

They can be held over periods of low prices and can be liquidated in periods of fair prices. In this tree products have the advantage of perishable farm crops which must be sold on markets often oversupplied and at "dumping" prices.

Certain it is that the proper reforestation of Pennsylvania idle land can add upwards of 100 million dollars to our state income each year, besides preserving and increasing social values - water and power increase and regulation; prevention of soil erosion, more hunting, fishing and recreation; and other services - all worth perhaps even more than the timber crops themselves. Reforestation is the only constructive use which will permanently solve the growing idle and delinquent tax land problem in Pennsylvania, as well as in other states where the idle land situation has grown critical.

LESSON 13. (b) Broadleaf Compound Alternate Leaved Trees (completed); locusts, Kentucky coffee tree; shrubs - Sumachs and Hercules Club, etc.

LOCUSTS (Robinia and Gleditsia)

The legume family (Leguminosae) which includes the trees hereafter discussed, is a vast group of bean or pod bearing plants, of which relatively few are woody, and among whom variety exists. The family has about 450 distinct genera with over 7,000 species and ranks near first in importance in the plant world. All leguminous species have alternate leaves and 5-part flowers, either of the "butterfly" (papilinaceous) type or regular. Many plants in the family have nodules or enlargements on their roots which develop as a result of symbiotic associations, or partnerships, with certain lowly organisms (bacteria) that possess the power of absorbing nitrogen from the air and fixing it in the soil, where it is one of the essential and very stimulating elements of fertility for growth of higher plants. The black or yellow locust has nitrogen fixing bacterial colonies in nodules on its roots, while honey locust and coffee tree do not.

KEY TO LEGUME TREES OF PENNA.

1. Leaves simple; twigs slender, unarmed - .. Red Bud (Cercis)
1. Leaves compound; twigs with thorns or spines or else very heavy and stout 2

2. Leaves always single-compound; twigs with 2 short spines or vestiges at leaf bases.... Black Locust (Robini
2. Leaves always or often twice-compound; twigs without paired spine at nodes 3

3. Leaves always twice-compound; twigs very stout and unarmed ..... Coffee Tree (Gymnocladus)
3. Leaves single - or twice-compound; heavy branched thorns present as a rule..... Honey Locust (Gleditsia)

The locusts have in common very heavy, hard, strong and durable wood. Their fruit is a flattened pod containing several to many hard beans. Honey locust pods and beans are several times as large as those of black locust. Both locusts are very late to leaf out in spring, and have sunken and inconspicuous buds in winter, which develop during the summer beneath the leaf bases. Neither of the locusts grow straight as a rule. Seeds are dispersed by wind, water, and wandering animals as the result of passing unimpaired thru their disgestive tracts.

COMMON BLACK or YELLOW LOCUST (Robinia pseudo-acacia)

Altho 7 species of Robinia occur in North America this is the only one of a size to be important. The rest are small trees and shrubs primarily of ornamental and botanical interest.

Twigs of this locust are more or less angular in cross-section and have no terminal buds. Lateral buds are small and set between the paired stipular spines. They are "monkey face" in appearance.

Leaflets are ovate and about 9 in number; subject to periodic severe attacks by a leaf mining insect which by successive defoliations sometimes kills older trees.

Flowers are creamy white and very fragrant, irregular, perfect, and borne in large showy pendant racemes just as the leaves are unfolding. Pods are 3 or 4 inches long and 1/2 inch wide. Seeds less than 1/4 inch long.

This locust gets 70 or 80 feet tall and 3 or 4 feet in diameter on favorable sites. It is a common fence corner tree and worthy of every encouragement in agricultural regions. In the forests it often spreads by rootsuckers after fires or clearcutting, and is a desirable species there on good sites. But where recurring severe fires have robbed the soil of organic matter and favorable biotic conditions, this tree is only a wretched weed so far as production of salable material is concerned. However, the scrubby, borer riddled, and worthless cripples which struggle along on scrub oak and fire coppice sites are very beneficial to their hardwood neighbors by virtue of ability to improve the soil and add to its nitrate content. The shallow roots of locust extend long distances beyond the tree crowns, especially on sandy soils, hunting every spot where moisture and fertility are available. Thus in the drought year, 1930, this locust was one of the most resistant trees, and really grew better than usual because the extreme heat seemed to be unfavorable to the insect enemies of the trees. Common locust is a lime lover, hence plantations

should never be made on sites where this element is notably deficient. Roots of the tree have a typical color and vile odor; are possessed of tonic, emetic, purgative medicinal value. Wood is an American standard for durability and does not swell or shrink, hence is especially sought for trenails for construction of wooden ships and for insulator pins on pole lines.

HONEY LOCUST (Gleditsia triacanthos)

The honey locust genus has 11 representatives in the world and 3 in the U.S. with this one in Penna. It requires good to very good soils for satisfactory development, but is free of insects and diseases, hence will grow slowly most anywhere if rodents and grazing animals let it alone.

Twigs medium stout, smooth, zigzag, without terminal bud; red brown axillary thorns often borne, especially on younger trees, usually branched and up to 6 inches long. Buds small, tuberculate and superposed.

Leaves fine and lacy in mass; 1- or 2-compounded pinnate, and rarely with a terminal leaflet. Flowers rich in nectar, borne in short greenish close drooping clusters (racemes) uniform in sex. Bark of young trees greenish, grading to dark brown, and has prominent lenticels; later breaks into near-black, firmly attached, hard, thick plates. Wood lighter in color than that of common locust and not quite as good. Heartwood reddish. Pods about 12 x 2 inches, reddish and crooked or twisted. Full of sweet pulp surrounding smooth seeds as large

as corn grains. This feature makes the pods palatable to many herbivorous animals and even usable for human consumption. In fact, the tree is sometimes called "St. John's bread" in reference to John the Baptist, and because of resemblance to the oriental carob tree. An occasional tree on good soils, but rarely or never met in forests of Penna.

KENTUCKY COFFEE TREE (Gymnocladus dioica)

This unique tree has the sexes on separate individuals, and is not very aggressive in the struggle for existence. In Penna. it is a rather rare ornamental and is generally called mahogany or mahogany bean tree, names for which there is no reasonable basis. The common name used in literature designates the optimum range of the species and commemorates pioneer days and war times when the large round seeds, about as big as small marbles, were roasted and ground or hammered fine to make a fairly acceptable substitute for coffee. Few if any animals will eat the hard seeds intentionally, but the pods are full of a green-yellow bitter-sweet pulp, so they are consumed with gusto, seeds and all, by larger animals and thereby rather widely scattered. When seeds are planted, only a few germinate the first year, and many never do so at all.

Twigs very stout, crooked, without terminal buds, covered with a silvery film, and with a large pink central pith. Buds small, gray downy, often superposed, sunken, and encircled by stiff red hairs.

Leaves 1 to 2 feet across and about as long, pinnately 2-compounded. Flowers are regular, green and white, in open terminal clusters about 4 inches long. Fruit a red brown leathery pod about 5 x 2 inches.

Bark breaks into small, thin, but hard scales. Wood very durable, heavy and strong, quite like chestnut in structure.

THE SUMACHS (Rhus sp.)

In Lesson 1 references were made to the poison sumach (Rhus vernix) and poison oak or ivy (R. texicodendron). Four other shrubby species in this genus are native in Penna., and the cashew or sumach family (Anacardiaceae) which includes the group is deserving of passing notice. All the plants in the family have acrid, resinous, or milky sap which renders them useful in medicine, tanning, for flavoring, and the manufacture of varnish and lacquers. The pistachio nut is the fruit of a tree related to the sumachs.

The species native in Penna. are covered in the below key. All have odd-pinnate compound leaves.

RHUS SPECIES OF WOODY STRUCTURE IN PA.

1. Terminal buds present; leaflets usually entire margined; berries white. Poisonous 2
1. Terminal buds absent; leaflets with toothed edges; berries red. Harmless 3

2. Creeping or climbing vine with trifoliate leaves - Poison Ivy or Poison Oak .....(R. toxicodendron)
2. Upright shrub or small tree with 7-13 leaflets always with entire margins ... Poison Sumach (R.vernix)

3. Leaf petioles winged, leaflets entire ....Dwarf Sumach (R. copallina)

3. Leaf petioles not winged, leaflets toothed on edges ... 4

4. Half erect, straggling, trifoliate shrub -Fragrant Sumach (R. canadensis)

4. Erect small trees or large shrubs; more than 3 leaflets 5

5. Twigs velvety hairy .....Staghorn Sumach (R. typhina)

5. Twigs smooth .....Smooth Sumach (R. glabra)

All species have milky-acrid sap and twigs with large central pith. Flowers green-white or yellowish. All are shallow rooters and tend to spread by root-suckers. Wood is relatively light and coarse, but attractive in color and fairly durable.

STAGHORN SUMACH (R. typhina) is sometimes deserving to be classed as a tree since it may grow to 35 or 40 feet tall and over a foot in diameter. It is rather commonly met all over Penna. Has ornamental value, and its red berries are a favorite winter food of many birds and small animals. The flower clusters of all the harmless sumachs are rich in honey and an acceptable bee pasture to the apiarist.

SMOOTH SUMACH (R. glabra) is very like staghorn sumach, but twigs are smooth and glaucous when young. It also is smaller and more crooked in habit. Rarely met in forest regions, but common along old fences, in abandoned fields, and open pastured woodlots and clearings.

DWARF SUMACH (R. copallina)

In general similar to smooth sumach, but has finer twigs, browner, and with very obvious raised red lenticels. The glossy leathery leaflets with entire edges and attached to a winged stem (petiole) are notable features.

The other members of the genus Rhus have been described heretofore in Lesson 1, and the key, well enough so the student should know them when he meets them.

HERCULES CLUB (Aralia spinosa)

This bizarre small tree or shrub belongs to the ginseng family (Araliaceae), and is its only American representative that grows vigorously enough to win botanical rating as a tree; sometimes becoming 30 feet tall and 6 to 9 inches in diameter. The huge spiny leaves are much like those of Ky. coffee tree. The heavy twigs are also usually armed and tipped with a vigorous terminal bud. Lateral buds are small and appresst. The big terminal panicles of perfect, whitish flowers; followed by ovoid, black, juicy, many seeded berries about 1/4 inch long are notable features. The innumerable small flowers are rich in nectar. Bark is smooth or nearly so, and wood is light, coarse, and brittle, with a large central pith column which is prominent even in large stems. Rootsuckers are the prevailing method of reproduction but birds carry seeds far and wide. Among the other shrubs in Penna. that have alternate compound leaves are several roses, prickly ash, and wafer ash.

All are minor species and of rare occurrence in the forests, but a few identifying characteristics are given below:

THE ROSES (Rosa sp.) are shrubs with brier like, scarcely woody stems, noted principally for beauty of their fragrant flowers. Fruit is a tough-fleshy orange to red button containing bony seeds, which however, often fail to develop.

SWEETBRIER (Rosa rubiginosa) is naturalized from Europe and has escaped cultivation in many localities. Its stout near-erect stems are greenish, with strong gray-brown recurved thorns; sometimes grows to 10 feet tall. Stems have a typical arched habit. Fruit obovoid.

SWAMP ROSE (R. carolina) has purplish stems up to 7 feet tall. Prickles vary in size and are usually somewhat curved. Leaflets fine serrate, at times downy below. Fruit globose. Locally common in meadows and along margins of swamps.

SMOOTH MEADOW ROSE (R. blanda) usually practically thornless, tho at times fine-prickly, and rarely grows more than 3 ft. tall. Flowers larger than in other species and usually solitary. Fruit obovoid. Stems red.

PASTURE ROSE (R. humilis) rarely exceeds 2 feet tall, erect stems have fine straight prickles and spines. Fruit is globose. Occurs on dry soils. Spreads by root suckers.

PRICKLY ASH (Xanthoxylum americanum)

This shrub and the wafer ash both belong in the rue family (Rutaceae) which includes a number of trees and shrubs with pungent aromatic and medicinal properties. Prickly ash usually occurs in thickets where it spreads by rootsuckers. Seldom exceeds 10 ft. tall, and its shoots resemble those of common locust superficially. All plants are pungent-fragrant. Buds red-brown, small, hairy, obtuse. Leaves dotted with oil glands. Flowers small, green white, with sexes on separate plants. Fruit a small fleshy berry containing 1 or 2 smooth black seeds.

WAFER ASH (Ptelea trifoliata) as the Latin name shows, has but 3 leaflets while the prickly ash is odd-pinnate and has several. This species is smooth in every part. It rarely or never root suckers. Buds borne sub-petiolar; downy white, obtuse; terminals absent. Trifoliate leaves have a "poison ivy" appearance. Flowers small and green. Seeds in pairs forming a flat wafer as big as a dime and winged entirely around. A quite rare species in Penna.

(c) Wood Identification - Ring Porous Hardwoods, Oaks, Chestnut, Ash, etc.

The ring porous woods have their largest and most numerous sap conducting pores, or tubes, in the spring wood portion of the annual ring. But in addition, there are scattered and smaller pores in the summer wood part of the rings. These small pores and the medullary rays are the best features whereby the important ring porous woods can be identified.

(1) Oak has fine summer wood pores arranged in radial lines; medullary rays very conspicuous, giving rise to the attractive and variable light colored flake or figure shown by quarter sawed oak. Wood heavy, hard, tough, strong.

(Note: Explain quarter sawing.)

A. In wood or White Oak group (white, rock or chestnut, post, bur, swamp white, and yellow oaks), the summer wood pores are very fine, numerous and crowded in the outer part of the summer wood. Spring wood pores are generally smaller than in the next group, (B) and often stopped up with a gray white deposit or growth (tyloses), which renders the wood impenetrable to liquids and makes it sought for tight cooperage (barrels, kegs, etc.), Wood pale to dark brownish; not reddish.

B. Red or Black Oaks (black, red, pin, scarlet, black jack, laurel, Spanish, and willow oaks) have summer wood pores few, and more scattered, but larger than in white oak woods.

Color of wood usually pale reddish brown, deeper near knots. Wood generally more porous than in the white oaks and not quite so heavy, strong, hard or durable.

(2) Chestnut wood is like oak in general structure but it lacks the wide medullary rays*, is lighter in weight; more porous, durable and easier to work. Very good wood for coarse construction, posts, poles, and positions exposed to soil and weather.

(3) Ash wood is in general like chestnut but heavier, harder, stronger, more elastic and has summer wood pores scattered singly or in groups and rows in that part of the annual rings. However, rows of pores never run radially, are relatively few in number tho fairly distinct to the eye. Color light but variable.

A. White Ash wood is the best of the group, and with that of the red, green, and blue ashes, is very hard and strong; preferred for ball bats, handles and vehicle parts where strength and rather light weight are important.

B. Black Ash is relatively soft, and even in texture; not so heavy or strong as wood of other eastern U.S. ashes.

(4) Sassafras wood is quite like ash in structure, but the very fine medullary rays are more distinct. Heartwood reddish brown, sapwood yellowish white; fresh cut sections have typical odor. Wood is rather light and brash but durable; relatively unimportant.

(d) Questions. Direct discussion to the subject of idle

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* Note: In addition to the obvious wide ones, oaks have numerous fine rays scarcely visible to the unaided eye.

lands primarily. Who owns them and why? Do they return any considerable tax income to society, make work, or serve man in any worthwhile way? What are possible uses for such areas?

(e) Field Trip. Take trip or hike to some area or locality where abandoned fields and farms or idle cleared lands can be studied. If these have grown up to brush and trees, note their kinds and discuss the quality of products (wood or other) they may yield. How does their growth rate compare with that shown by suitable coniferous trees planted on similar sites? Is the stand likely to be complete or even? How is the form of the trees at hand?

Why were the lands originally cleared? What lead to their present disuse? Have they eroded because of unwise cultivation? Will they be needed in the future for production of farm crops, - say in course of next 100 years? Are they suitably located for home sites in reference to roads, schools, churches, and other needs of civilized existence? How do they serve in respect to game cover and propagation, or sport and recreational uses?

LESSON 14. (a) Advanced State and National Forest Policy.

References:

Forestry Almanac, 1933, American Tree Association, Washington, D.C.

A National Plan for American Forestry (Copeland Report in response to S. Res. 175), Senate Document #12, 1933.

U.S. Forest Policy by John Ise, Yale University Press, New Haven, Conn., 1930.

Forest Policy in Foreign Lands

The forests of old countries like China, India, Japan, Germany, Italy, Greece, Spain, and France have had to sustain tremendous wood drains for ten centuries or longer. It is most instructive to note results, and see how or why they have been able to survive in some instances and have been destroyed, or have degenerated terribly, in others. In practically every instance these countries show that an advanced rational forest policy must be in force, or else man slowly, but certainly and utterly, dissipates and devastates the forest resources of a nation. China in the main is an eloquent testimonial to disasters and deterioration of every sort which goes with unrestricted forest destruction.

Japan stands as a sharp contrast to China. The Japanese are the greatest lovers of nature and natural beauty among all the peoples of earth. The humid climate and rugged topography are all very favorable to forest growth and render

forest fires almost impossible. But the greatest cause for the good forests of the country is the fact that two thirds of all the forest land has always been government owned, or enclosed and reserved in the "temple forests" where little or no cutting was allowed. In recent times the government has practiced excellent forestry both in Japan and Korea.

The forests of India are extremely variable but considering climate and the teeming population, it is remarkable that the woodlands are still so productive. The explanation is largely in government control or ownership of nearly three fourths of the forests. Down thru the ages the native princes claimed the forests and often unduly restricted cutting. The present forestry practice in the country is quite satisfactory.

Italy, Greece, and Spain, in general are classic examples of what will be found inescapeable when forest regulation is unknown. Each succeeding generation cuts a little harder and pastures a little closer, until the forest disappears and erosion finally renders both forestry and agriculture impossible or ineconomic. Asia Minor and the northern mountain and coastal countries of Africa exhibit the same results. Centuries of expensive afforestation effort are needed to restore tree growth on sites where it should have never been removed.

Germany is the home land of modern practical forestry as a business on a scientific and progressive basis.

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Except for farm woodlands of small individual and aggregate area, nearly the total forests of the country are under definite and strict forest working plans. These permit cutting only an amount of wood equivalent to the growth.

France affords one of the best examples of good forest policy over a long period of years. Almost without interruption since 1669, this country has enforced a definite policy to conserve and improve its forest resources. In consequence, French woodlands contrast and excel notably in value and productivity when compared with those of neighboring Spain and Italy, - enjoying about the same climatic conditions.

American Forest Policy

In America to date, forestry has moved softly and those in the profession have generally failed to assert themselves so aggressively as the exigencies of the situation demand. One reason why American foresters lack militancy is the fact that nearly all are employed by governmental agencies, and scarcely dare express themselves, or else they work for the very lumbermen who are devastating the forests. However, progress is being made along certain lines. The people are gradually becoming forestry minded. Much information has been collected on American forests and forest trees. Forest research has been given recognition and support, altho not so much as it merits. The fact that public forestry is going forward has disposed the people toward land

purchases to enlarge this work, rather than attempting compulsory control and direction of private forestry on the areas.

The northeastern states show the most advanced forest policy in general, with the Federal government following close, and possibly ahead of the states in some lines of management as well as in its research program.

New York has been very successful in solving the forest fire problem, in quantity distribution of forest planting stock to private land owners, and in getting a substantial sustained land purchase program under way. This latter is now aimed particularly toward the purchase and reforestation of farm-lands once cleared and now dropped from cultivation. However, the State Forest Preserves of 2,294,000 acres area are kept under lock and key, purely as a vast wild life park or wilderness and hunting ground.

Pennsylvania leads in rational treatment of its state forests which total 1,612,000 acres in area. It also has a good Auxiliary Forest Reserve law for the relief of taxation on private owned lands, but this law has been used relatively little to date. Pennsylvania has taken the lead in forest research among the states, and also in developing the recreational and game possibilities of its large state owned areas. In addition to the area of State Forests above discussed, the public owns 330,000 acres of State Game lands, and leases a considerable area also, for wild life refuges and shooting grounds. These latter activities and land

purchases are financed by a resident hunters' license. Progress has been made in forest fire prevention and suppression, but the problem is difficult because of industrialization, dense population, and large areas of high hazard.

Maine has had a forest service since 1891, but owns no state forests. It especially aims to protect the forests, encourage recreational and tourist use, and help its landowners to grow pulp and paper wood. Special research work has been done on problems of forest entomology.

The foregoing three states show advanced forest policy among different lines and serve to illustrate in the main what all the states are doing in possibly a somewhat less intensive or extensive way.

(b) Tree and Shrub Identification; Broadleaf simple opposite leaved trees (complete); Maples, catalpas and flowering dogwood; shrubs - smaller dogwoods, lilac, viburnums and honeysuckles.

THE MAPLES (Acer sp.)

The maple family (Aceraceae) includes but one minor species in addition to the genus Acer; but there are 75 maples in the world with 13 species in the U.S. and 6 in Penna., exclusive of the naturalized Norway and sycamore maples that were introduced years ago from Europe and are now among our commonest dooryard and street trees; hence the family is a noteworthy one in the study of Temperate Zone trees. Maples are said to rank ahead of all other tree genera in importance as shade and ornamental specimens.

The typical features of the maples are (1) opposite leaves and buds with a vigorous true terminal one, except in cases where it is replaced by a flower cluster, and (2) the fruits in form of paired and united keys (samaras). Nearly every other part of the tree shows wide variation among the numerous forms in this interesting genus.

The below keys from "Penna. Trees" will enable the student to know our native and naturalized maples in both summer and winter.

Summer Key to the Maples

1. Leaves simple 2
1. Leaves pinnately compound .... *Box Elder (A. Negundo)

2. Leaf petioles with acrid milky sap (Norway Maple (A. platanoides)
2. Leaf petioles without acrid milky sap, ... 3

3. Flowers in terminal racemes, ... 4
3. Flowers in lateral clusters, appearing before or with the leaves 6

4. Flowers appear with the leaves, Sycamore Maple (A. Pseudo-platanus)
4. Flowers appear after the leaves, ... 5

5. Flowers in erect racemes; leaves coarsely serrate and usually 3-lobed ..... Mtn. Maple (A. spicatum)
5. Flowers in drooping racemes; leaves finely serrate, 3-lobed at apex, at first brown, pubescent beneath . ..... Striped Maple (A. pennsylvanicum)

6. Flowers opening before the leaves, the drooping fruit ripening in spring or early smmmer, ... 7
6. Flowers opening with the leaves, drooping fruit ripening in summer or early autumn, Sugar Maple (A. saccharum)

7. Flowers with petals; leaves bright green above, pale green nearly glabrous beneath, 3-5 lobed; fruit keys incurved, ... Red Maple (A. rubrum)
7. Flowers without petals; leaves green above, whitish or silvery beneath, deeply 5-lobed; fruit keys divergent, ... Silver Maple (A. saccharinum)

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* See discussion under "trees with opposite compound leaves".

Winter Key to the Maples

1. Buds stalked, with few exposed scales, ... 2
1. Buds sessile or nearly so, with 6 or more exposed scales, ... 4

2. Buds evidently-stalked; bark streaked longitudinally with white lines .....Striped maple (A. pennsylvanicum)
2. Buds short-stalked; bark not streaked longitudinally with white lines, ... 3

3. Buds small, 1/5 of an inch long including stalk; twigs reddish-brown to dingy gray; pith brown, ... Mtn. maple (A. spicatum)
3. Buds large, ovoid, the terminal one acute, the lateral obtuse and closely appressed; twigs greenish-purple and glaucous; pith, light,*Box Elder (A.Negundo)

4. Buds with 8-16 exposed scales, brown, acute, non-collateral, leaf-scars nearly encircle stem, ... Sugar maple (A. saccharum)
4. Buds with 6-8 exposed scales, red or green, obtuse... 5

5. Terminal buds small, generally less than 1/5 of an inch long; terminal and lateral buds of same size; collateral buds present 6
5. Terminal buds large, generally over 1/5 of an inch long; terminal buds larger than lateral; collateral buds absent 7

6. Twigs red and lustrous; bark rough but not flaking in large pieces ..... Red Maple (A.rubrum)
6. Twigs bright chestnut-brown; bark falling away in thin large flakes .....Silver maple (A.saccharinum)

7. Buds red; leaf-scars encircle stem; lenticels scattered; lateral buds appressed; bark black, fissured, not scaly, ... Norway maple (A. platanoides)
7. Buds green; leaf-scars do not encircle stem; lenticels numerous; lateral buds projecting; bark brownish and scaly .....Sycamore maple (A.Pseudo-platanu

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* See discussion under "trees with opposite compound leaves".

SUGAR MAPLE or HARD MAPLE (Acer saccharum)

This is one of the most common trees of the cooler parts of Pennsylvania. Sometimes it attains a diameter of 5 feet and height of 120 feet. It is always attractive, and becomes truly majestic when seen nearing maturity under favorable forest conditions.

Sugar maple is a modest and rather slow grower in nature, as it commonly starts under heavy shade and after years of perseverance reaches a "place in the sun." While this maple is a beautiful tree for roadside and individual planting, and grows more rapidly under such conditions than in the forests, nevertheless hot sun, wind, and insect enemies often damage it so that its days are cut short by storm or ice. Wherever this maple occurs naturally it is worth favoring, but planting for forestry purposes should be restricted to areas where there is some shade and a fairly constant moisture supply, but good drainage.

Maple sugar and syrup are important products of this tree. Their production and use should be encouraged in every way. Trees of a foot and over in diameter should yield 3 or 4 pounds of sugar if tapped seasonably. In New York state 12 or 13 quarts of sap are required to make a pound of sugar. A tree is recorded which was tapped but once and in a single spring yielded 23 pounds of sugar. This production has never been surpassed.

Sugar maple is a prominent member of the beech-birch-maple forest type. It is a notable soil builder and improver as the leaves decompose quickly into mild forest humus. Pure stands of young trees form an extremely dense crown canopy, but are liable to stagnate in growth and suffer from enemies. It is best to have some deeper rooting and thinner foliaged trees such as red oak, basswood, white ash, and black cherry admixt in the maple forest.

Bark of the sugar maple is at first smooth and pale brown, but gets darker and channeled into long irregular ridges from which coarse, irregular plates or flakes loosen on old trees. Wood is hard, heavy, strong, fine and close grained. It is not resistant to decay, but serves a host of uses both great and small; interior finish, furniture, and novelties are most notable. Curly grain, birds-eye figure, and burly growths are highly valued in cabinet making. The causes for such variations in wood structure are still matters of conjecture.

Sugar maple has flowers of both sexes on the same tree as a rule, but they occur in different clusters. Seeds ripen in September and persist a long time until strong winds occur to scatter them far and wide. This helps to account for a range from Newfoundland to Florida, Texas and Manitoba. Seedlings often occur by millions under and near parent trees.

BLACK SUGAR MAPLE (A. nigrum) is commonly considered a variety of Acer saccharum, as it has similar sharp pointed brown scaly buds and most other features, yet it tends to occupy warmer and less acid soils and is probably a distinct species. Leaves are darker, smoother lobed, and tougher than those of sugar maple and are distinctly hairy below.

MOUNTAIN MAPLE (A. spicatum)

This small tree is often only a shrub in reality when habit and size are criterions. It forms a good soil cover due to the tendency to rootsucker and sprout from the base whenever the weak stems are broken down by ice storms and wet snows. However, foresters dislike this cover because the shade cast is too heavy for most tree seedlings to survive beneath. Probably only sugar maple and beech can make headway on sites where mountain maple holds possession, and even their seedlings may succumb to competition from the dense mats of shallow roots whenever hot, dry summers occur.

The stalked buds, glaucous coated twigs and other features stressed in the key suffice to identify this clumpy little tree of cool rocky slopes, ridges, and mountain glens.

STRIPED MAPLE (A. pennsylvanicum)

Goose-foot maple, moose-wood, and whistle-wood are designations earned locally by this tree. Leaf shape and size explain the first. The second refers to the preference

of the stately moose in the northern wilderness for the tender and attractive twigs and buds of the tree. The third local name describes the custom of boys in spring, taking advantage of the readiness with which bark slips, to make whistles or fifes from smooth and slender stems. These give forth a piercing, but querulous and variable note, that is a sure sign spring has arrived in the cool hill and mountain sections from Nova Scotia to Minnesota and south along the Allegheny Plateau to Georgia.

Striped maple has much in common with the smaller mtn. maple, but its flowers and fruits occur in drooping clusters, and it attains under most favorable conditions to 30 or 40 feet in height and nearly a foot in diameter. It is a short-lived associate in both the beech-birch-maple type of forest, and in white pine-hemlock, with sporadic occurrence in stands of mixt oak and chestnut.

Bark is at first red or greenish and then a bright green with strikingly prominent white stripes that persist for years. The bark is slow to become rough, but finally shows rather narrow flat topped ridges with shallow fissures between. Wood is soft and white at first, but pinkish brown in color when heartwood forms. Despite its merit judged by looks, this crooked and rather interesting little tree is a forest weed, occupying space that might better be filled by species of economic importance.

SILVER MAPLE (A. saccharinum)

This soft maple under favorable moist and sheltered site conditions becomes one of our largest members of the genus. However, because its wood is so weak and brittle, storms usually wreck it more or less completely, and as the wood is predisposed to decay, old trees are commonly misshapen and so irregular or crippled as to merit contempt instead of praise; altho young trees are really beautiful and vie with the best of the group for shade and ornamental use. The silvery under surfaces of the leaves, which account for the common name, are an especially attractive feature, as is also the long double curved sweep of the lateral branches.

Silver maple bark is at first smooth and gray, but soon shows shallow furrows, and then the flat ridges begin to develop thin flakes or plates typical of older trees.

Wood of silver maple is fairly hard, but not comparable in this respect to sugar maple. It is medium in strength, fine in grain, and easy to work. Paper pulp, furniture, fuel, and small articles, are commonest uses of the wood, which with that of box elder and red maple are marketed under the designation "soft maple".

The features listed in the keys for summer and winter identity, describe silver maple quite well. It is a stream bank species and is rather exacting as to site. Has little value for forestry except for use on areas subject to periodic inundation. The sap yields excellent sugar, as is

also true in case of red maple, but the saccharine content is much lower than in sugar maple. Silver and red maples bloom very early "on bare twigs" and ripen seeds in early May.

RED MAPLE (A. rubrum)

Where this tree commonly occurs more or less mixt or near sugar maple it is called soft maple, while in many localities it is known as swamp or water maple. The last two names denote its ability to exist on sites with slow moving, near-stagnant ground water where few other trees compete for the site. The tree is probably the most common woody plant of Pennsylvania, as it is almost ubiquitous at all elevations and regardless of soil moisture and fertility conditions; tho, of course, on sterile dry slopes and ridges growth is slow. The common name refers to the red autumn coloration of the tree, its bright red twigs in winter, and color of the flowers.

Red maple leaves are silvery beneath and it has a good many features in common with its frequent associate, the silver maple. However, it much surpasses the latter for street and door-yard planting. For these purposes the U.S. Dept. of Agriculture gives this tree first rank over a large area of the northeastern part of the country. Ability to maintain a thrifty appearance on nearly every kind of soil and freedom from storm and other climatic injury are good points in its favor.

Red maple has the same range as sugar maple and grows nearly as big on suitable sites.

NORWAY MAPLE (A. platanoides)

This European tree, native from Norway to Switzerland is doubtless the most widely distributed shade tree of the world. Its milky and bitter sap seems to protect it against serious insect pests, and smoke, dust, or fumes do not bother it much, hence it is especially commended for use in city parks and along streets. The heavy shade it casts and shallow rooting render Norway maple undesirable for lawns where grass turf is wanted.

Bark is fine ridged, but not scaly. Seeds are flattened with wide spreading wings. This and the preceding species, red maple, usually have the sexes on separate trees or on different limbs of the same tree.

SYCAMORE MAPLE (A. pseudo-platanus)

This is the "forest maple" of Europe and sometimes grows 120 feet tall and more than 3 feet in diameter of bole. Bark of trunk is divided into wide flat ridges from which flakes or plates are shed. It is more exacting as to soil, moisture, and atmospheric conditions than is Norway maple, hence is less commonly planted in towns and cities. Sycamore maple has leaves almost as broad as the oriental plant tree or sycamore. Its heavy twigs have green buds. Seeds have rounded nutlets with wings only slightly divergent. Both Norway and sycamore maple yield white or near white, fine grained wood of

good quality, and intermediate in density and strength between our "hard" and "soft" maples. Wood of all maples lacks durability when exposed to the weather.

THE CATALPAS (Catalpa sp.)

These trees with showy trumpet shaped flowers, cigar shaped fruit pods, leaves in whorls of 3, and large simple leaves, belong in the trumpet creeper family (Bignoniaceae). They yield durable, rather strong, soft, light, but coarse textured wood. The wide distribution of the two species is due to their promotion years ago as a splendid potential source of fence post and rail material. The propaganda in behalf of the trees was largely buncombe, but it sold considerable seed and a good many trees from the nurseries. Neither of the catalpa trees in native in Penna. Their wood is light brown with a satiny lustre and odor like kerosene.

COMMON or EASTERN CATALPA (C. bignonioides)

This tree was originally found from Georgia to Florida and Mississippi. Now it may be met anywhere east of the Rocky Mtns. and south of New England and Canada. Twigs are yellow brown and stout with tips often frozen back in winter. Lateral buds small and appear embedded in the bark. Leaves fall quickly after the first hard frost, and their scars on the twigs are nearly round. Bark is light brown, flat ridged-scaly. Flowers June and July; less than 2 inches long, in large showy

panicles. Pods are about as big as a lead pencil and thin walled. The flat seeds have narrow fringed wings. Tree usually decidedly crooked, slow in growth and rarely above 30 to 40 feet tall except on the best soils.

HARDY or WESTERN CATALPA (C. speciosa)

Very like the eastern catalpa but is less liable to damage by winter cold, and grows straighter and more rapidly, altho it too is decidedly exacting as to site. In the Middle West where this tree is native, it sometimes gets 120 feet tall and 4 feet in diameter on the best alluvial soil.

Hardy catalpa has thicker bark and larger fruit pods than the eastern species. Its seeds are also larger with broad fringed wings. Flowers are borne in May and June and exceed 2 inches long. Tree is usually fair in form. It is badly attacked in most localities by the green larvae of the Catalpa sphinx moth, and seems to suffer worse from this pest than the preceding species. Should only be planted on good agricultural soil, if plantations for posts are proposed.

THE DOGWOODS (Cornus sp.)

The dogwood family (Cornaceae) of 16 genera includes 85 tree and shrub forms in the Temperate Zone. Nyssa and Cornus are American representatives of the family, and are most readily separated by the nearly universal opposite leaves of the dogwoods and alternate ones of the black and sour gums (Nyssa sp.).

There are about 40 woody kinds of Cornus in the world, with 13 of these in the U.S. of which 4 are classed as trees. Pa. has 8 dogwoods large and small, of which 2 are trees and one is exceptional by reason of having alternate simple leaves, and has therefore been covered elsewhere in this outline.

FLOWERING DOGWOOD (Cornus florida)

This is the best dogwood in the woods and while usually only 15 to 25 feet tall, sometimes grows up to 40 feet with diameters between 12 and 18 inches to the south of Pa. As it usually has but a single stem, this dogwood deserves to be considered a tree. It is the "glory of the understory of our northern forests" when the blooms illumine the spring landscape. The beauty of the bloom is not due to the small flowers that are borne on a capitate head or button, but to the 4 or more petalloid bracts which surround the head. These bracts are really the developed and glorified scales which enclosed and protected the clustered flower buds all thru the preceding winter, as may be proven when one notes their scarred and frost bitten tips.

Twigs are red tinged with green, smooth and often glaucous; tips are upturned with a pleading effect like a beggar's fingers. Leaf buds are small and more or less hidden back of the persistent bases of the shed leaves. The flower buds are terminal and button-like. All vegetative buds have 2 valvate scales.

Leaves are ovate acute; clustered toward tips of

twigs. Midribs and larger veins are characteristically sunken when a leaf is viewed from above.

Fruits scarlet, ovoid, with a grooved stone; borne in clusters 2 to several; 1/2 inch or more long.

Bark on old trees breaks in an "alligator" pattern.

Wood very hard, heavy, dense, close-grained, and strong. Ideal for shoe lasts, turnery articles, maul heads, wedges, and tool handles. It is pale reddish to pink in color with distinct medullary rays.

ROUND-LEAVED DOGWOOD (C. circinate)

This species is distinctly a shrub, as it has a typical clumpy habit, and reproduces more or less by root-suckers and from natural layers when snow or other accidents press the slender stems to the ground. Commonly met on cool rocky sites, growing 6 to 10 feet tall.

Twigs warty dotted, greenish brown. Buds acute, short-stalked, appresst. Leaves broad ovate to nearly round, dense downy below. Flowers in a flat umbel like elderberry or wild carrot. Berries lead-white to pale blue, globose, bitter.

RED OSIER DOGWOOD (C. stolonifera)

Like preceding species but found on moist to wet sites. Twigs are shiny, dark red to bright purple. Leaves ovate to oblong-lanceolate, entire, acute or acuminate. Fruit whitish and about 1/4 inch thru. Grows 3 to 8 feet tall, and as

the technical name indicates, is often propagated by natural layering.

PANICLED DOGWOOD (C. paniculata)

This shrub often forms dense thickets along roadsides, in fence rows and abandoned fields. It is like the preceding species but has much finer twigs, smooth, gray to brown in color. Flowers and berries in panicles 2 to 4 inches long. Leaves narrower than those of red osier dogwood. Grows 2 to 10 feet tall, often on dry and relatively sterile soil.

ARROW-WOODS and HAWS (Viburnum sp.)

This genus and the honeysuckle (Lonicera sp.) belong in the honeysuckle family (Caprifoliaceae). Their berry type fruit is attractive to birds and small animals, and like that of the dogwoods, is distributed far and wide. All species found in Penna. are shrubs in reality, tho two are classed as trees (see "Penna. Trees"). The drupe fruits of Viburnum have flat melon type seeds. Flowers are small, white, 5-part, in umbels similar to elderberry.

MAPLE-LEAVED ARROW-WOOD (V. acerifolium)

Stems straight, slender, smooth, terete, dark brown. Leaves like red maple. Buds dark red brown, acute, only slightly appresst. Fruit purple-black. Grows 2 to 5 feet tall; spreads by rootsuckers, usually on rocky, poor, but fairly

moist soils.

DENTATE ARROW-WOOD (V. dentatum)

Twigs brown to ash-gray with 4-sided tendency; lateral ones acute, brown, close appresst. Leaves pinnate veined, about 2 inches long, broad ovate to rounded; base cordate at times; edges coarse and sharp serrate. Fruit dark blue. Frequents moist to wet soils; 6 to 10 feel tall, much branched.

SWEET VIBURNUM (V. lentago)

Twigs reddish to orange, smooth; odorous when crushed. Buds long, slender, scurfy red-brown, lateral ones close appresst, terminal ones enclosing flowers are much swollen at their base. Leaves ovate-acute, about $2\frac{1}{2}$ inches long; edges closely and sharply toothed. Fruit black or dark blue, sweetish.

Small tree or large shrub, 10 to 20 feet tall, met locally in moist woods and along streams.

WILD RASIN (V. cassinoides) is a swamp-loving shrub in most respects very like sweet viburnum, but its leaves are often obtuse, wavy-toothed, or entire. Twigs are scurfy dotted.

BLACK HAW (V. prunifolium)

This species is usually rated as a tree, and may grow to 25 or 30 feet tall and 8 or 10 inches in diameter, but is usually much smaller, and tends to form thickets by root-suckering. In many respects it resembles sweet viburnum, but

its twigs are stiffer, more numerous and spiky, often with a film or bloom. Laterals make an angle of 75 degrees with their parent stem. Buds are shorter and paler than in sweet viburnum, and fruit far more palatable. Grows on fertile to medicore well-drained soils.

HOBBLE-BUSH or "TRIP-UP" (V. alnifolium)

Bark purplish gray. Branches often long and more or less prostrate, rooted at the tips. Twigs stellate hairy. Leaves pinnate veined, broad ovate to round and 3 to 8 inches long, cordate, toothed, abrupt, acute, deep-corrugated above. Flowers of two types (sterile and fetile), commonly occur in each cluster. Berries red to purple. Found in moist, shady woods, - frequent in virgin hemlock forests.

HONEYSUCKIES (Lonicera sp.)

This genus has much in common with the Viburnums but its flowers are tubular and fruit is a berry with more than one seed.

AMERICAN FLY HONEYSUCKLE (L. canadensis)

In the understory of cool, moist forests, this shrub, rarely more than 5 feet tall, may be met occasionally. Its translucent red berries, borne in pairs and about 1/4 inch thru. are really beautiful. Leaves are ovate-oblong, acute, downy below when young, stalked, with bases round or cordate.

Flowers appear shortly after the leaves, are yellow green, perfect, and about 3/4 inch long.

GLAUCOUS HONEYSUCKLE (L. dioica)

Is a twining or 1/2 erect, smooth vine. Seldom more than 8 feet tall. Leaves show a glaucous bloom below, are oblong, with upper 1 to 4 pairs fused around the stem and bearing yellow to purplish flowers in their axils or as a terminal cluster. Berries red. Frequents moist woods and stream banks.

JAPANESE HONEYSUCKLE (L. japonica)

Is a naturalized ornamental twining vine which has become a coiling, strangling pest in the woodlands of some localities. While its flowers are fragrant and attractive, and it is useful for protecting banks against erosion, nevertheless this vine is a forest weed that should be kept strictly within bounds, or better still, ruthlessly exterminated.

THE LILAC (Syringa vulgaris)

This fragrant anddelightful Old World flowering shrub often persists about abandoned home sites throughout Penna. It is a representative of the olive family (Oleaceae). Its typical large opposite, green, blunt buds, with terminal ones usually missing, readily identify the lilac in winter. The dark green, slender stalked, paried, entire leaves are typical in summer.

(c) Wood Identification.

Ring Porous Woods: Hickory, Elms, Locusts, Etc.

(1) Hickory has pores in its summer wood only slightly smaller than in the spring wood, but they are isolated and scattered. In the annual rings are fine concentric pale lines (not pores, but wood parenchyma) which are about as distinct as the very fine medullary rays. Summer wood part of ring tinged red toward outer side. Wood very heavy, hard, strong, tough, elastic, but not durable when exposed to the weather or in contact with the soil. Sapwood broad and nearly white. Heartwood reddish brown and not so elastic and tough as sapwood according to vehicle makers, who formerly used large quantities of hickory. Makes best axe handle in the world. Rather coarse wood as a rule.

(2) Persimmon wood is much like hickory in structure, but its fine concentric lines in annual rings are much finer than the medullary rays. No red tinge in annual rings. Sapwood creamy white; heartwood blackish. Finer in texture than hickory; can be substituted for ebony; not important.

(3) Elms have wood with wavy or branching lines of fine to minute pores in the summer portion of the annual rings; medullary rays indistinct. Heartwood reddish brown; sapwood grayish to reddish white. Wood heavy, hard, strong, very tough, and fairly durable; hard to split usually because of

cross grain; check and warps badly in curing, but takes a high polish when rightly handled and shows remarkable figures in furniture. Barrel hoops and wheel hubs were important among the multitude of minor uses to which elm wood is adapted.

(4) Hackberry wood is very similar to elm but its fine medullary rays are very distinct; color greenish white. Heartwood absent or hard to distinguish. Wood of little importance.

(5) Black or Yellow Locust has minute pores in the summer wood, scattered singly or in short broken lines whose course is never radial; medullary rays fine but distinct. Heartwood yellowish brown; sapwood very narrow and yellowish; shades of red and green may occur in wood. Wood is very heavy, hard, strong, tough, coarse, very durable, shrinks considerably and liable to warp in seasoning.

(6) Red Mulberry wood is quite like black locust but not so heavy, hard or tough, and has very minute summer wood pores usually in little clusters of 3 to 8. Heartwood light orange brown; sapwood whitish. Rather uncommon wood, highly considered for posts, small cooperage and many minor uses.

(7) Osage Orange has wood rather like black locust but medullary rays are minute and scarcely distinct; radial section pale yellow in color; very hard, heavy, strong and durable, but rather brittle; heartwood brown on cross section, with sapwood

yellow; excellent for posts, railroad ties, and inlay work.

(8) Honey Locust wood has many features like black locust but the medullary rays are fine, they are conspicuous and visible to the naked eye; heartwood is red in color, sapwood thin and pale lemon. Quite rare wood with many excellent qualities but used mostly for posts and fuel.

(d) Questions.

Why are ring porous woods, especially such as chestnut and ash, stronger when cut from fast growing trees, while among the coniferous woods the strongest material is that cut from slow growing trees?

(e) Field Trip.

Go out and collect and study by comparison on the ground as many of the ring porous woods as possible; taking along ax, sharp knives, and hand lenses if possible. Of course, no good trees should be felled for study, but limbs can often be cut off trees, stumps may be available for study and identification; noting in this connection that decay attacks and affects woods very differently.

The above study trip does not mean that specimens of wood need not be secured in advance by the forester, labeled, and handed around among the students when the lecture is given; so they get a first hand idea of the color and weight of woods, and by cutting see how hard they are. These study specimens

should be from old boards, boxes, crating, posts, or furniture, so far as possible; since the seasoned commercial samples of wood are more typical than material found in a limb or stump.

LESSON 15. (a) Government Control of Private Forest Lands.

References:

(1) Public Regulation of Private Forests by W.N. Sparhawk, pages 993-1050 of Copeland Report (A National Plan for American Forestry) by Secretary of Agriculture in Response to S. Res. 175, Washington 1933.

(2) Forestry Almanac (1933)- American Tree Association, Washington, D.C.

(3) Forestry in Sweden and Adjacent Lands - by Geo. S. Perry, 1929.

(4) Economics of Forestry- by B.E. Fernow, 1902.

Lessons that precede show how the public loses when forests are cut and exploited without restriction. Therefore, to protect public interests in the wood requirements of the nation, navigation, national defense, water supplies, climatic influences, sport, and recreation, the government is fully justified in compulsory private forestry where that is deemed wiser than public ownership and management.

In America and some other lands too, government ownership and business operations are looked askance. From a political standpoint, it may lead to a hazardous centralization of power. Moreover, the expense of land purchase and costs for reforestation and development are so stupendous as to be a real burden to the nation, and utterly impossible for many of our American states. The alternative is private ownership under public control and direction.

The above proposal is not at all revolutionary. It

IRREGULAR PAGINATION

has several legal bases. The titles to land originate in the government. Since four-fifths of all American forest lands are in private title, the "public welfare" certainly demands that they be handled in the public interest, and with a long time viewpoint instead of mere present gain.

Governments always have the right to expropriate, seize, or take land and other property for public use. It is, therefore, obvious that minor encroachments on private property in the general interest are justified. Railroading and many other private enterprises are strictly regulated because they impinge on the public interests - why not forestry?

Private Forests in Foreign Lands

Nearly every older foreign country has rather stringent regulations covering the management of all forests. Some of the restrictions date back to about 1500, and tho neglected or poorly enforced around the time of the French Revolution, today are very important and necessary to forest productivity.

Most foreign countries forbid clearing or excessive cutting in private forests unless by special permission of the government. Many require the reestablishment of a forest cover within 5 or 10 years on all sites cut clear and not adapted to, and needed for agriculture. Grazing recently cut forest is commonly forbidden, as is also the old practice of raking and removing litter from forest soils.

The Czechoslovak republic requires that every forest property more than 250 acres in extent must be managed under a working plan drawn by trained foresters and specifying the amount and location of the cut for 10 to 20 years in the future. These plans provide for sustained yield, so far as practicable, and must be approved by government forestry authorities.

In Switzerland and a good many countries private forests are classified depending upon topography and location. The forests on steep slopes, at high elevations, and essential areas elsewhere, are closely restricted as to cutting, and sometimes grazing is prohibited or limited.

Sweden and Finland have provincial or local conservation boards whose main duty is the inspection and regulation of private forestry. Each board employs trained foresters and such other personnel as may be needed.

France has probably the most complete and exacting code of laws (Code forestier) for the guidance of private woodland owners. In case the more important provisions of the code are disregarded, forest lands are taken over by the government and handled in an approved manner. The original owner may redeem his property by payment of all costs plus interest and taxes, otherwise the land becomes public property in fee.

Germany has no national forestry but the various states are all very progressive in their treatment of the forest,

so that public and private lands are managed along model lines. All in all, forestry in Germany averages about the best in the world, with Switzerland, France, Czechoslovakia, Denmark, Austria and Sweden not far behind, and offering some examples of forest management, that surpass what is found in Germany.

Tho Russia has now no private forests in legal sense, yet considerable areas have been allotted to villages, agricultural communes, workers' associations, and even individuals, for use and management. The holders must protect these forests from fire, theft, and over-grazing, and must follow working plans prepared at cost by government foresters. No clearing dare be done without approval. Openings that do not reforest naturally must be planted up. If holders do not comply with requirements their forests are forfeited to the State.

Regulation of Private Forestry In America.

State laws require complete slash disposal on private lands after lumbering in California, Oregon, Washington, Idaho, Montana, Minnesota, southern Florida and northern New York. Twelve states, including Pennsylvania, require the disposal of slash or elimination of special hazards on private property in certain situations such as along roads, railroads, or near buildings.

Fires are the greatest curse American forestry must combat. Nearly all states make it a misdemeanor (in Nevada

a felony) to start uncontrolled fires on one's land which may burn on to the property of another. The laws of 32 states restrict more or less stringently the burning of grass, brush, or slash. Among the common restrictions are the requirements that advance notice of such intended burning must be given adjoining property owners, or that fire lanes be cleared around the areas where burning is to be done, permits to burn must be secured from fire wardens or similar public official, or a general provision may require that "all due precautions" be taken to prevent the spread of fire to other lands.

In 8 states and the Forest District of Maine forest owners are required to provide protection against fire on their property, or to support protective organizations which will take care of the problem.

Several states require that forest owners aid or cooperate with government officials in the struggle to combat such pests as pine bark-beetles, gipsy and brown tail moths, tent caterpillars, elm-leaf beetle, white pine blister rust, and "any other tree or shrub destroying pest" in Massachusetts and Vermont.

In 22 states provisions of a varying sort apply to <u>auxiliary state forests.</u> Pennsylvania has one of the best auxiliary state forest laws, but it has never been taken advantage of by woodland owners, except in a few minor instances. In general, while this class of forests are under certain restrictions as to cutting and treatment, there is a compensating

relief from taxes, or similar benefit (See Lesson 13-a).

Louisiana and New Hampshire have laws designed for compulsory prevention of forest denudation. These are "seed-tree" laws and have in general been rather futile. One or two seed trees, usually chosen to comply with the law rather than to guarantee reproduction, and often blown down by the storms of the first winter, are utterly inadequate to cope with forest devastation as too often practiced by the lumber industry, and permitted by careless land owners.

On the whole, present state laws to regulate the handling of private forests are not very effective. Those on the subject of fire prevention are fairly well enforced in the North and West. But no real private forestry is now being practiced in the U.S. on a scale commensurate with our needs, or in keeping with the intelligence and dignity of the American people. So long as no universal national law or regulation steps in, private forestry, - by and large - will continue to be a farce and a delusion.

The National Recovery Act (1933) is so wide and general in its powers delegated the President of the U.S. that he can doubtless put any restrictions he may choose on lumbering and utilizations. It is to be hoped that something will be done which may inure to the permanent practice of rational forestry on private lands in America.

Disregarding all the "bunk and baloney" issued on this subject and getting out of the "fog";two things are certain:

(1) Every forest property above 500 acres in area should be managed under a forest working plan permitting in perpetuity only the cutting of as much wood as is replaced by growth; unless the land be of quality suitable for permanent agriculture and is needed for such use. (2) Uniformity in working plan provisions and enforcement must be secured by federal inspection and approval.

(b) Tree and Shrub Identification. Broadleaf compound opposite leaved trees (completed); Ashes, Box Elder, Horse Chestnut and Buckeyes. Shrubs - Elderberries, Bladdernut and Trumpet Creeper.

THE ASHES (Fraxinus sp.)

The genus (Fraxinus) includes about 40 trees or large shrubs of which 16 are native in the U.S. and 5 in Penna. As a group, only the oaks exceed the ashes in importance among our hardwood trees. The scientific name is from the Latin verb meaning to split, and refers to the fact that the tough and strong wood with straight and even grain, can be split readily into thin strips so as to be plaited into baskets and other wickerware. The ashes are the outstanding forest tree group in the olive family (Oleaceae) which includes many ornamentals and some forms of importance in horticulture. In general, the ashes require good soils and tend to be moisture lovers. They sprout vigorously from the stump when cut and their seed are borne considerable distances by wind; and may be carried miles by running water. Since the sexes are found on different trees, single isolated specimens rarely bear much good seed. The key-like seeds of ash are typical.

Ash wood is notably strong and elastic which adapts it for use as base-ball bats, handles, vehicle parts, cars, barrel hoops, and a host of other purposes.

Twigs of the ashes have large pith relative to their size, with a tendency to be flat where the paired buds occur. At

tips of twigs there are 3 buds as a rule, the middle and true terminal one is the largest on the twig. Frequently it is attacked by insects, and then a fork or crook is certain to develop.

KEY TO THE ASHES IN PENNA.

1. Leaflets sessile; seeds flattened and surrounded by a broad wing; bark scaly; buds black and acute .. .. Black Ash (F. nigra)
1. Leaflets stalked; seeds not flattened; bark ridged; buds not black ..... 2.

2. Twigs and leaves practically smooth ..... 3.
2. " " " downy pubescent ..... 4.

3. Seeds short and thick; leaves silvery beneath; leaflets wavy or irregularly toothed on margin; only half-acute; growth fairly straight .. White Ash (F.americana
3. Seeds and wings elongated; leaflets acuts, green beneath, toothed on edge; growth curved and crooked as a rule ..... Green Ash (F. lanceolata)

4. Seeds elongated, wings extending half way to base of seed ..... Red Ash (F. pennsylvanica)
4. Seeds short and thick with wings practically attached to end of seed ..... Biltmore Ash (F. biltmoreana)

WHITE ASH (Fraxinus americana)

This is the best ash in the world. It grows straighter than most of the group and is more adaptable than many other ashes. The bark with regular ridges showing diamond shaped fissures between is helpful for winter identification. The purple autumn coloration is also unique. The white ash grows rapidly on good soil with a fair to abundant moisture supply, but should not be planted or encouraged on hot dry slopes or open ridge sites. More

white ash trees have been grown in Penna. forest nurseries than any other hardwoods, but successful plantations are more because of planting so often on improper sites.

The silvery underleaf surfaces of white ash are an aid to knowing the tree in summer, while the stiffer and straighter habit of the tree is very notable in winter.

BILTMORE ASH (F. biltmoreana)

This tree does not attain such large size as white ash, which it resembles in many respects, neither does it grow as straight or rapidly. It is more exacting as to soil moisture and in Pennsylvania is limited to stream bank localities in the southern counties. It is said that the wood of this ash has a pinkish color cast. The leaflets have longer stalks than in other ashes and are rather irregular in conformation with pale and hairy under surfaces.

BLACK ASH (Fraxinus nigra)

This typical swamp tree of Pennsylvania whose wood has served many homely purposes goes by various names in different localities. It is called hoop ash where the wood has been used in cooperage. Basket ash is a name given where the wood is soaked and then beaten until it separates along the annual rings into thin strips, that can be woven into a strong and durable basket.

Black ash is more like the European common ash (F. excelsior) than are our other species. It is a tree deserving of encouragement wherever found naturally, and might well be introduced on wet sites where the soil is not too acid.

Ash burls are occasionally formed on the bole, at the base, or on branches of black ash. These imperfectly understood developments yield a beautiful figure for use in cabinet making.

The smooth bark of black ash, with irregular development of soft corky ridges and projections is typical; as are also the acute yellow to dark green leaflets, practically devoid of stems. In winter the pale to yellowish gray twigs, tipped with dark brown to black buds, show sparse but prominent raised lenticels. Twigs are heavier and less numerous than in other ashes.

Wood is softer than that of most ashes and reputed more durable. Heartwood is dark brown, contrasting with the white sapwood so sharply, that it is accountable for the accepted common name and the frequent appellation brown ash.

RED ASH (F. pennsylvanica)

This medium size tree rarely exceeds 2 feet in diameter and 50 or 60 feet tall. It grows along streams and where the soil is moist and fertile. Downy twigs and leaves are typical of this tree, but in a few localities where the Biltmore ash occurs other features must be noted. The acute

tipped seeds, whose long narrow wings extend half way to the base of the seeds, are reliable ear marks of the tree but are also common to the green ash, which some botanists consider a variety of this tree. Acute leaflets with evenly sharp serrate margins are characteristic. Buds are acute with striate outer scales.

Wood is lighter than that of white ash and not quite its equal in strength and elasticity. Bark is rather similar to that of white ash but less regular, and growth habit is less desirable.

GREEN ASH (F. lanceolata)

Stream bottoms with the preceding tree, Biltmore ash, box elder, silver maple, and swamp white oak, are the usual habitat and associates of red ash. Except that leaves and twigs are smooth, green ash and red ash are very similar in superficial features. However, green ash grows to 70 feet tall and yields heavier stronger wood. The acute, serrate margined leaflets, with upper and lower surfaces nearly the same shade of green, and the acute buds, are best identifying features.

BOX ELDER or ASHLEAF MAPLE (Acer negundo)

Except for its compound leaves, this tree is a typical maple (See notes on genus Acer). It is a rapid grower on good soils and may become 75 feet tall and up to 4 feet in

diameter. In some localities box elder is a veritable weed, as its light seed blows or floats considerable distances, and all germinate to form vigorous saplings a year or two later.

In summer box elder is distinctive with 3 or 5 coarse serrate leaflets composing its opposite leaves, beneath whose stout bases are sheltered the white wooly, round-obtuse buds which aid greatly in winter identification. When the leaves fall their united scars encircle the twigs.

Twigs are green to red and purple in color, often with a pale glaucous bloom. Scattered raised lenticels occur on the twigs. Buds are short stalked.

Bark is at first yellowish gray but becomes darker and fissured with narrow ridges.

Flowers and the fruit (paired keys) are borne in drooping clusters. Sexes are usually on separate trees.

Wood is soft, light, fine grained and easy to work. Used for paper pulp and the manufacture of numerous small articles, as well as interior finish of houses occasionally. The sap yields maple sugar, but is not so sweet as that of some other maples.

BUCKEYES and HORSECHESTNUT (Aesculus sp.)

The trees in this group belong in the soapberry family (Sapindaceae). These names were derived from the fact that the inner bark, husks, and crushed fruits will give rise to foam or suds when agitated in water, and certain species

have been used as dirt removers. The common names buckeye and horse chestnut refer to the appearance of the base of the very attractive nuts, and the fact that they are not edible. If a horse ever ate them it was in absence of other food and because he was tied and unable to forage on thorns, bark, wood and other relatively more tasty articles. Flowers in large terminal panicles or clusters.

The opposite palmate compound leaves and heavy twigs are typical features of Aesculus. Wood is soft, white, light, fine in grain, and lustrous.

Bark is furrowed with broad ridges, breaking into plates.

SWEET BUCKEYE (Aesculus octandra)

This is the largest tree of the genus native in North America, growing to 80 or 90 feet tall at times and attaining to 3 feet in diameter. In Penna. it is only native in two or three southwestern counties, but may be found planted elsewhere now and then. Sweet buckeye refers to the fact that the nuts of this tree are tasty enough to be eaten by hogs and cattle, while those of the two succeeding species are rejected. When consumed in quantity it has poisonous effects. It is said that flour made from the dried nuts is excellent for paste, as it will not be eaten by moths or other insects.

Flowers are small and yellowish to purplish and appear early in May or before, just as soon as the leaves are fairly expanded. This tree is very early in making its new growth in spring and then remains at a standstill all thru the growing season, - as is also true of other trees in the group.

Nuts are borne in a soft smooth leathery husk. Buds of both native species are smooth and non-resinous. They also both have commonly 5 leaflets instead of 7 as in horse chestnut.

SMOOTH BUCKEYE (A. glabra)

This is the Ohio buckeye, and in Pennsylvania is limited to the western part where its range is somewhat wider than that of sweet buckeye. It is distinguished most easily from the latter tree by having fruit husks with sparse scattered soft spines.

Flowers are yellow to greenish. The name fetid refers to the evil smell given off when twigs or leaves are bruised.

Wood is preferred for artificial limbs and wooden ware, also good for paper pulp. Tree grows to 75 feet tall and 2 feet in diameter. Both our buckeyes are lovers of fertile and moist but well drained soils.

HORSE CHESTNUT (A. hippocastanum)

This very ornamental tree has a world wide distribution. Its masses of bloom, pink and white to mottled or red-washed are its most notable feature. The leaves which fall for months and the nuts are a nuisance for street planting. Nuts are borne in a sparse and soft prickly husk.

This tree has usually 7 leaflets, and the very large buds are gummy resinous. These features distinguish it from our native buckeyes.

BLADDERNUT (Staphylea trifolia)

This is the sole representative of the bladdernut family (Staphyleaceae) in the U.S. It is a large shrub up to about 15 feet tall found along larger streams and on moist slopes adjacent. Leaflets are three, as the species name indicates. The blunt globose buds are reddish gray in color and are strictly paired, since a true terminal bud is practically always absent. Twigs greenish to dark reddish brown varied with short pale gray stripes.

Fruit is a 3-celled, 3-horned bladder, containing several hard, glossy, pale pearly to yellow brown, very hard, pea-like seeds. The inflated baloons or bladders are adapted to travel by air and water. They aid in giving the shrub a rather wide distribution over favorable sites.

Flowers are white borne in drooping axillary racemes or clusters.

TRUMPET CREEPER or TRUMPET VINE (Tecoma radicans)

This is the type plant of the trumpet creeper family (Bignoniaceae) of which the catalpas are tree representatives. It is a vine creeping or climbing by aerial rootlets. Twigs are yellow brown and without terminal buds; having paired appressst lateral buds at each node.

Leaves are opposite, pinnate compound; leaflets ovate-acute and toothed. Flowers orange-red, 5-part, trumpet shaped, about 3 inches long, and in open clusters. A few of them develop into pods about the size of a cigar, within which are numerous white winged seeds arranged about a central core or placenta which divides the interior of the pod into two chambers.

An attractive deciduous climbing vine which is commonly associated with ruby-throated humming birds, beds of bergamot, and all the rest that goes with old fashioned gardens.

ELDERBERRIES (Sambucus sp.)

The elders belong in the honeysuckle family (Caprifoliaceae), resembling most the viburnums and true honeysuckles with their berry type of fruit. The large pinnate compound leaves with toothed acute leaflets are distinctive,

however. Twigs are fragile with a large pith region and lack a terminal bud. Flowers are small and closely set. Fruit is 3 to 5 seeded and the size of number 5 shot. Buds are conical acute; vary in size from 2 up to 12 feet and are shrubby in habit; give off an evil smell when crushed.

COMMON ELDER or BLACK-BERRIED EIDER (Sambucus canadensis)

Twigs have white pith. Leaflets 5 to 11. Flowers in flat umbels. Berries nearly black when ripe and insipid in taste. Much esteemed for pies and jelly. Eaten with avidity by birds whereby seeds are scattered from Manitoba and Nova Scotia to Texas and Florida. Occurs on fertile moist soils; forms thickets by rootsuckering. A shrub of warm agricultural valleys. Odor of plant faintly unpleasant.

RED-BERRIED ELDER (S. racemosa)

Because of its rank and nauseating odor this shrub is often called stinking elder and poison elder. This pronounced odor may also account for the fact that birds, insects, and small animals will not eat the fruit, except under compulsion of starvation.

Twigs are warty and stems more woody than in common elder; pith brown. Only one or two stems occur together as a rule. Leaflets 5 to 7. Flowers appear very early in spring; greenish white, in dense panicles. Berries red and very persistent. A shrub of cool mountain slopes and coves.

(c) Wood Identification.

Diffuse Porous Woods

Pores more or less visible to naked eye, or so arranged as to resemble ring porous woods, - Walnut, Butternut, Black Cherry, Birch and Cottonwood.

(1) Black Walnut has pores varying from large to minute in transition from spring to summer wood, thus giving a ring porous appearance. Wood relatively heavy, hard, strong; heartwood, especially on lengthwise section, chocolate brown; sapwood whitish. Favorite cabinet wood of the U.S.; works well; because of freedom from splintering when broken by shock, is best wood for gun stocks; takes good polish, durable, much used as veneer in furniture industry and for interior finish.

(2) Butternut or White Walnut is like black walnut in structure but wood is not strong, light and soft with pale reddish brown heartwood; an attractive cabinet wood.

(3) Black Cherry wood has pores all minute and indistinct but most numerous in the spring wood, giving rise to lighter colored zones or lines (especially on lengthwise sections), and appearing finely ring porous; medullary rays very fine but very distinct. Wood relatively heavy, hard, strong, fine textured; works well, takes good polish, and is fairly durable; heartwood reddish, sapwood yellowish white. A beautiful cabinet wood.

Wood of the domestic or sweet cherry is softer, lighter and in every way inferior to that of the wild black cherry. Wood of the fire cherry or bird cherry is still softer, - weak and light, - so as to be nearly worthless, even if it grows to size large enough for utilization.

(4) Birch has pores indistinct but larger than most other woods in the diffuse porous group. Pores are even in size and distribution over the annual ring, usually visible as fine gray specks on smooth new cut cross-sections. Sapwood whitish; heartwood reddish. Wood heavy, hard, strong and fine in texture, tho these features are less pronounced in wood of the red or river birch, and paper birch. Black or cherry birch is best in quality and not very different from wood of the black cherry; the latter can be distinguished readily by its wider medullary rays when radial sections are compared. Birch is not durable when exposed to weather or moisture changes, but it is being better appreciated as a cabinet wood with passing years. Birch wood is excellent fuel and serves to make almost innumerable small articles of turnery. Most of the birch lumber in U.S. commerce is derived from the yellow birch.

(5) Cottonwood (Aspen, "Popple" or Poplar, - not Tulip or Yellow Poplar). All the trees of the genus Populus yield very soft, light, weak, and non-durable wood of a white, grayish, yellowish, or brownish color with a silky sheen or luster.

Pores are evenly distributed and uniform so the wood is homeogeneous in texture; in some species pores are visible to the eye. Inferior woods of rapid growth, but well adapted to use for paper pulp.

(d) Questions. Direct discussion to government owned forests as compared to government compulsion or regulation of forests held under private ownership. Which will get results?

(e) Field Trip. Go to some place where aspens or cottonwoods are growing thriftily. By some means demonstrate or measure growth of these Populus species and compare with that made by oak or the pines, etc., on same or similar sites. Can wood of Populus be made to serve suitably for posts, poles or in contact with the weather? (Preservative treatment will give durability but not hardness or strength).

Locate specimens of wood of as many of the species in the lesson as possible, and get students to appreciate their differences and contrast when compared with ring porous wood.

Take men out on a final field test in tree and shrub identification. Have each man provide himself with paper and pencil. Assign a number to certain typical trees and shrubs to serve as test or examination specimens. When the papers are handed in, the instructor by comparison with his own list, can show what each man has been able to get out of his opportunity to know the woody plants of the locality.

LESSON 16. (a) The Social and Economic Position of Forests in the Nation.

To picture the position of forests in our national life, we must see that our very existence, as well as our comforts, luxuries and recreations all root in the land and its wise use. Our food and clothing come from the agricultural crops and animals. Agriculture and graxing generally use the lower valley and plains lands. Together they do not utilize over 60% of our national land area. Besides food and clothing we must have water for irrigation, power, industrial and home use; homes; fuel; which with a myriad of wood products from sunday papers to coffins, the forest lands (32% of our land area) must furnish. We visualize these 600 million acres of forest and brush land as lying in patches on the rough lands spotted throughout the farms, but more especially in great belts on the higher mountainous areas separating the small and large agricultural valleys and plains.

On these mountainous watersheds all of our important rivers rise. In their upper or lower stretches they furnish water power, and water supplies for cities, and still further down water for irrigation, and many are navigable and carry commerce. But to furnish these services their watersheds must be kept forested as far as possible to regulate the water run-off and prevent erosion, which when uncontrolled silts up reservoirs and dams, covers low farm land with debris, and clogs irrigation works, drainage canals and navigation. This water regulation is probably the forests greatest service to the nation.

IRREGULAR PAGINATION

Individual forest owners derive no income from it. It is the first and greatest reason for extended government forest ownership.

Back of the water storage, run-off and erosion control effected by large areas of forest cover, are the still more basic effects on temperature fluctuations and rainfall, the measurement of which and the effect of which on climate are somewhat clouded, but nevertheless appear quite real.

The next group of social services yielded by the forests are their rapidly growing use by more and more of our common people for recreation - hunting, fishing, camping, and study of forest wild life, and the associated health factors. This use again would warrant public forests, were there no prospects of valuable timber crops and increased labor employment ahead.

Civilization is constantly fouling the air with products of animal and fuel combustion - the chief of which is carbon-dioxide. This goes on at a constantly increasing rate as animals, human beings, heating plants, power plants and internal combustion motors increase. Plants, and particularly trees draw on this air supply of carbon, which through the action of the green leaf clorophyl, is fixed in plant compounds. Wood of trees has a greater amount of carbon than most other plant tissues. This removal of carbon and carbon compounds from the air is a service performed by large forest areas difficult to measure, that trees get most of their substance from the air, instead of from the soil

is also not generally known to our people.

The above functions of the forest are general and cannot be readily capitalized as income to the forest owner (hunting rights sometimes are). They are the chief reasons for government forest ownership.

But in addition to these vital forest functions, the materials in the trees themselves are of the utmost value and economic importance. The value of our 600 million acres of forest and brush land with the primary wood using industries is estimated at 10 billion dollars for the nation. The gross value of our forest products approaches 2 billion dollars in noamrl years. Although we <u>export</u> 250 million dollars worth of forest products, we <u>import</u> over 400 million dollars worth including paper.

Normally we employ 1,300,000 workers in the forest and wood-working industries. In addition the building industries employ a large number of carpenters and wood workers. Forest products make up 8 percent of the revenue freight for our railroads which themselves use 120 million dollars worth of ties and timber per year.

The mines use 45 million dollars worth of timber annually.

In Pennsylvania the primary wood manufactures may be itemized as follows:

PRODUCT	VALUE (million dollars)
Paper and pulp	37
Lumber and timber	11
Farm wood products, posts, fuel, etc.	8
Cooperage	5
Wood distillation	4
Hewed ties, mine timbers, poles, fuel wood (not from farms), etc., estimated	10
Total primary wood products,	125

In addition secondary manufacture takes the lumber, paper or pulp and adds values (raw material excluded) as follows:

PRODUCT	VALUE ADDED BY MANUFACTURE (million dollars)
Furniture	31
Planing mills	19
Paper boxes	11
Coffins	8
Wooden boxes	6
Cardboard	2
Wall paper and other paper manufacturing	10
Carriages, wagons, sleds	2
Agriculture implements & misc. part wood, estimated wood part	11
Total	100

Thus we see that wood products in Pennsylvania are directly responsible for products valued at 225 million dollars in normal years. General reforestation and building up of our forests can multiply this by 4.

It follows that the forest industry is a most important factor in the livelihood of our people and the income of the state and nation.

The important thing about these basic products of farm and forest, and of the manifold social services of the forest, is that they are soil products, which may be removed, replaced, and even improved and their quantity and services increased. Although at the present moment the agricultural crops seem to have increased beyond our immediate needs, proper buying power of our own people and foreign nations, would take the full crops. This is particularly true if the poorest farm lands were returned to forest growing, since we lack 40% of growing as much wood as we are normally cutting. Less farm crops and more forest crops will add to our economic prosperity and increase the social service of better and more forest lands.

When our coal, oil, gas, iron, lead, gold and silver and other minerals are exhausted, as some time they must be, some earlier, some later, we must find substitutes. They are exhaustible resources. Of these, fuels-coal, oil, and gas- will probably first reach the limits of economic production. Coal, oil and gas are the stored up remains of an early vegetation. Some time the human race must derive their substitute fuels from

current plant growth after the reserves are exhausted. This may tax our land production. We cannot afford to reduce to unproductive desert large areas of our productive soils by erosion and forest fire. Even if we were not cutting our forests 40% faster than they are growing, which guarantees a satisfactory market for timber from any extension of reforestation we can reasonably accomplish, this holding and maintaining the fertility of our soils, with the other social benefits from the forests, would require the prompt arrest of the deforesting process still going on, and the reforestation on a national scale of the lands now idle and disintegrating. We must extend our forests now.

LESSON 16 (b) Wood Identification.

Diffuse Porous Wood

Pores very fine, and not visible to unaided eye. Beech, Sycamore, Maple, Tulip Poplar, Red Gum, Basswood, Black Gum, etc.

(1) Beech has pores minute or indistinct, even in size, and uniformly distributed over the annual ring. Some of medullary rays are broad, as in oak. Wood fairly easy to split, reddish white to reddish, heavy, hard, stiff, strong, rather coarse, not durable; shrinks and checks in drying, but takes a good polish and is being used for many minor and miscellaneous purposes.

(2) Blue Beech (or Water Beech) is similar to beech in structure and most features, but is white in color; and because of its fluted trunk, annual rings are very sinuous with the large medullary rays occurring where the ring course is concave. These large rays are really compound, being formed by fusion of several small ones. A rare and in general unimportant wood.

(3) Sycamore (Buttonwood) has all or nearly all its medullary rays large, as can best be seen in a tangental section; is otherwise like beech, tho not quite so heavy, hard, or strong. Very difficult to split.

(4) Maple wood is rather variable in weight, hardness, and associated features, but it has no wide medullary rays, as these

are fine to very fine but distinct; color creamy to reddish white with dark reddish tinge at outer edge of summer wood; "bird's eye", curly, and "blister" figures occur in this wood and increase its value from the standpoint of use in furniture or for interior finish. Sugar Maple (hard maple or rock maple) is best of the genus. It is excellent for flooring and furniture, inlay work, and the like. No maple wood is durable, but when wood of sugar maple is creosoted, it makes a very good railroad tie. Red Maple (swamp maple) has wood much softer than sugar maple when green, but when once seasoned it is nearly as hard, tho called soft maple in localities where the latter tree occurs. Silver Maple and Box Elder (soft maples) have wood far whiter, softer, lighter, and weaker than sugar maple.

(5) Holly is very like hard maple but is white without any reddish tinge.

(6) Tulip Poplar or Yellow Poplar (white wood) is relatively soft but varies considerably; in general like maple in structure, but pores are more numerous and crowded so they almost fill spaces between the medullary rays; color yellowish white, often with greenish tinge in heartwood. Wood is easy to work, even in grain and fine textured, stiff but not strong, occurs in large clear sizes; ideal for wood carvings.

(7) Cucumber has wood almost identical with tulip poplar, possibly averaging a little heavier.

(8) Red Gum (Sweet or Starleaf Gum) has wood rather like tulip in structure, but color of sapwood is grayish, and heartwood pale to dark reddish brown; it is also stronger and tougher than tulip and often shows cross or curly grain and pleasing figures that fit it for use in furniture and for interior finish. Wood is resistant to splitting, hence lends itsself splendidly to veneering and when correctly treated is a satisfactory furniture wood.

(9) Basswood (Linden) is very like tulip poplar but the pores are not nearly so crowded between the medullary rays; heartwood brownish white to very light brown. Wood even and fine in texture, and often lighter, easier to work than tulip poplar as a rule.

(10) Black or Sour Gum (Tupelo) has medullary rays so fine that they are indistinct to the eye, altho plainly seen under a hand lens and conspicuous in radial sections. Wood hard to split, sapwood yellowish gray, heartwood grayish brown, heavy, hard, tough, strong, fine in grain, cross grained and cross fibred; warps and checks badly; non-durable. Trees of Genus Nyssa were long considered weeds and worse than worthless, but now their wood fills many special uses and is being marketed in quantities.

SHORT KEY FOR IDENTIFICATION OF COMMON WOODS OF THE U.S.

(Numbers in parentheses on right side of pages give lessons and species therein, other numbers refer to later key headings at left side of pages)

1. Woods non-porous (conifers ..... 2.
1. " porous (broadleaf hardwoods) ..... 13.

CONIFERS

2. Resin ducts present ..... 3.
2. " " absent ..... 7.

3. No distinct heartwood; resin ducts small and not numerous; wood light, soft .....Spruce.(11-1).
3. Heartwood distinct ..... 4.

4. Resin ducts few and irregular in distribution ..... 5.
4. " " numerous ..... Pines 6.

5. Resin ducts often combined to form lines on cross-section; heartwood orange reddish ... Douglas Fir (11-2).
5. Resin ducts scattered; heartwood pale rusty brown - .....Larch (11-3).

6. Gradual transition from spring to summer wood in annual rings; wood white to yellowish red. Soft Pines(11-4).
6. Abrupt transition from spring to summer wood - ..... Hard Pines(11-4).

7. No distinct heartwood ..... 8.
7. Heartwood distinct ..... 9.

8. Wood yellowish white; soft, light, weak..... Fir (12-1).
8. Wood reddish or rose tinted; splintery, light, strong, ... Hemlock (12-2).

9. Wood fine grained, aromatic or peppery ..... 10.
9. Wood tasteless and odorless as a rule ..... 12.

10. Heartwood purplish to brownish red - Juniper (12-3).
10. Heartwood nearly like sapwood yet distinctive 11.

11. Wood peppery and typical in taste and odor - ..... Incense Cedar (12-7).
11. Wood with spicy resinous taste, soft, fine ..... White Cedar (12-6).

12. Annual rings irregular and uneven- ..... Bald Cypress (12-5).
12. Annual rings fine and regular..... Redwood (12-4).

13. Pores with pronounced concentration in spring wood ..... 14.
13. Pores more or less scattered thruout annual ring 25.

Ring Porous Woods

14. Medullary rays very conspicuous ..... Oaks 15.
14. Medullary rays fine and inconspicuous ..... 16.

15. Dense wood. Very fine summer pores crowded in latter (outer) part of annual rings- ..... White Oaks (13-1).
15. Wood more porous than in white oaks; summer pores few and scattered - .... Red or Black Oaks (13-1).

16. Pores of summer wood in radial branching lines- ..... Chestnut (13-2).
16. Pores of summer wood scattered or in lines not radial ..... 17.
16. Pores of summer wood nearly as large as those in spring wood. Fine concentric lines of wood parenchyma present ..... 24.

17. Pores in summer wood clustered.....Red Mulberry (14-6).
17. Pores in summer wood not clustered ..... 18.

18. Summer wood pores in concentric wavy lines ..... 19.
18. Summer wood pores scattered or in irregular lines 20.

19. Medullary rays fine but very distinct; wood greenish white ..... Hackberry (14-4).
19. Medullary rays fine and indistinct; wood reddish to grayish or brownish white ..... Elm (14-3).

20. Sapwood pale lemon, heartwood red .. Honey Locust (14-8).
20. Heartwood not red ..... 21.

21. Medullary rays minute indistinct ..... 22.
21. Medullary rays very fine yet distinct ..... 23.

22. Wood rather light, brash, aromatic .. Sassafras (13-4).
22. Wood heavy, hard, strong, yellow brown - .....Black Locust (14-5)

23. Wood heavy, hard, and not yellow in radial section- ..... Ash (13-3)
23. Wood very heavy and hard, yellow in radial section - .....Osage orange (14-7)

24. Heartwood light reddish .....Hickory (14-1)
24. Heartwood blackish .....Persimmon (14-2)

Diffuse Porous Woods

25. By reason of pores or color, wood appears ring porous ..... 26.
25. Pores all minute or indistinct and evenly arranged 28.

26. Pores vary from large to minute in spring and summer wood respectively ..... 27.
26. Pores most numerous in spring wood making it paler ..... Cherry (15-3

27. Wood heavy, hard; heartwood chocolate brown- .....Black Walnut (15-1
27. Wood lighter, soft; heartwood pale reddish brown - ..... White Walnut (15-2

28. Broad medullary rays present 2
28. All medullary rays fine 3

29. Nearly all medullary rays broad, crowded. Wood hard to split - ..... Sycamore (16-3).
29. Some medullary rays fine. Wood splits readily ... 30

30. Broad medullary rays sharply defined; wood reddish white to reddish ..... Beech (16-1).
30. Broad compound medullary rays; wood white - ..... Blue Beech (16-2).

31. Medullary rays small to very small but distinct... 32.
31. Medullary rays indistinct to naked eye ..... 36.

32. Wood hard to medium ..... 33.
32. Wood soft to very soft ..... 34.

33. Wood reddish white, variable in hardness; summer wood red tinged .....Maple (16-4).
33. Wood white, hard and fine textured ..... Holly (16-5).

34. Pores very numerous and crowded ..... 35.
34. Pores not crowded; wood soft with white to very pale brown color .....Basswood (16-9).

35. Color of wood yellowish white, often greenish heart-wood - ..... Tulip and Cucumber (16-6 & 7)
35. Gray sapwood and dark red brown heartwood -Red Gum (16-8).

36. Medullary rays visible on radial section. Wood very hard to split; heartwood grayish brown - Black Gum (16-10)
36. Medullary rays visible with lens, heartwood reddish. Wood easy to split - ..... Birch (15-4).
36. Medullary rays indistinct even wider lens. Wood very soft, white, or brown shaded, with a silky lustre -..... Populus - (Aspen or Cottonwood) (15-5).

(c) Questions.

(d) Field Trip. Visit a furniture factory, cabinet maker's shop, or some other wood using industry where different hardwoods are being worked. Let students examine as many woods as possible.

Go to a 5 & 10¢ store, or similar emporium where small wooden articles are sold, and buy a few items made in whole or part of wood. See how well the students can identify the woods used in the articles.

Give fellows a final test or examination on about 25 numbered specimens of wood. In this way they can demonstrate to themselves and the instructor just how much they have gotten out of the course.

End of Title